SCIENCE

JUNE 12, 1953

VOLUME 117 NUMBER 3050

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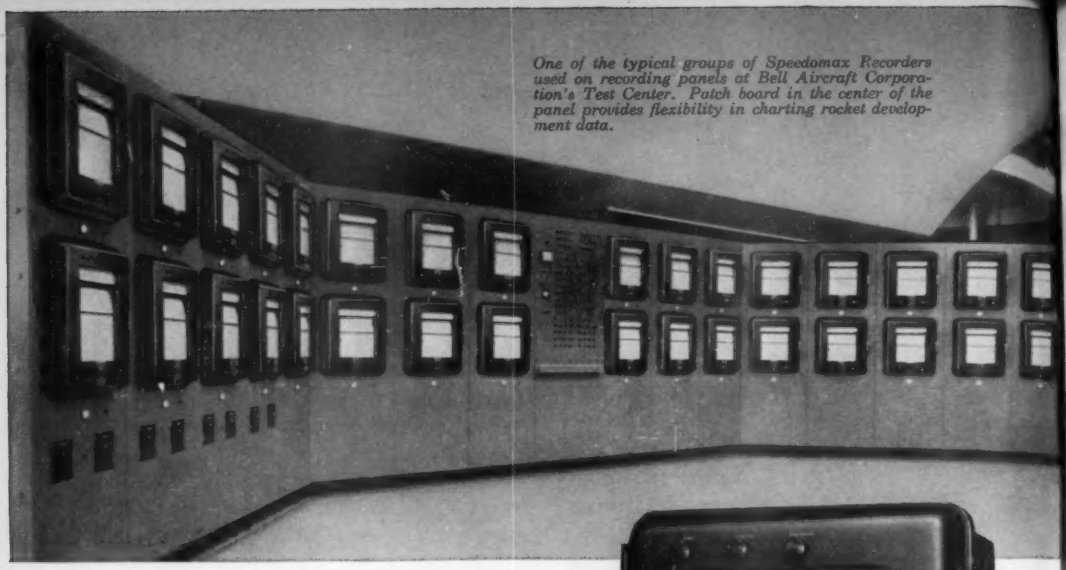
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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This is a new and clearly written general chemistry text for science and chemistry majors. Following the current trend in freshman courses, it emphasizes the theoretical aspects of the subject. The authors show how important theoretical concepts have been derived from experimental findings.

Especially notable for their clarity and modern tone are the discussions of the theory of electrolytic solutions and the electronic theory of acids and bases. The 32-column chart of elements is presented, but the 18-column and 8-column charts are also included. A greater-than-average amount of organic chemistry is placed earlier in the book than is usually the case.

Systematic Discussions of:

chemistry and the scientific method; three states of matter; atoms and molecules; hydrogen, oxygen and water; solutions; classification of elements; atomic structure; nuclear chemistry and atomic energy; electrons and valence; chemical equilibrium; acids and bases; oxidation-reduction; introduction to representative elements; the non-metals; open chain compounds; closed chain compounds; solutions in electrolytes; equilibrium in electrolyte solutions; electrochemistry; colloidal dispersions; analytical chemistry; systematic properties of the related metals and the similar metals; metallurgy; the metals, carbohydrates, fats and proteins; polymerization — rubber, rubber substitutes, plastics.

A special summary precedes each chapter and a set of questions and problems follows. Answers are supplied separately to the instructor.

By W. F. Luder, A.B., Ph.D., Professor of Chemistry, Northeastern University; Arthur A. Vernon, B.S., M.S., Ph.D., Chairman, Department of Chemistry, Northeastern University; Saverio Zuffanti, B.S., Ch.E., A.M., Professor of Chemistry, Northeastern University. 593 pages, 6" x 5¼", 173 illustrations. $6.00. *New.*

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SCIENCE

Institute of Animal Resources

THE need for adequate standards and methods in the procurement of biological materials for research, assaying, testing, and teaching has become increasingly acute. Special problems often require special types of materials, and the purity and supply of such stocks must be assured.

Prompted by these considerations, the Chairman of the Division of Biology and Agriculture of the National Research Council, Paul Weiss, set up an organizing Committee on Animal Resources under the Chairmanship of C. C. Little, of the Jackson Memorial Laboratory, circumscribing its tasks as follows:

1) *Definition and standards*: The constitution and relevant properties of animals used for investigations and tests (their genetic constitution and purity, including degree of variability; their nutrient status; their freedom from disease; their special sensitiveness and susceptibilities, as well as other criteria of vigor) will have to be objectively defined according to accepted scientific standards. The setting of minimum standards of acceptability and maximum limits of tolerance will not only be of great practical service but should gradually lead to more universal adherence to rigorous research standards, thus creating an increasing demand for the standardization of materials.

2) *Production*: It will be necessary to insure an adequate supply of genetically defined strains for specific purposes (e.g., cancer strains; breeds with special resistance or sensitivity to particular pathogens; races with special nutrient or metabolic characteristics, etc.). This implies, besides the maintenance of existing strains of value, the continual search for new useful mutations.

3) *Certification*: Standards of identification, heredity, nutrition, health, etc., of biological materials must not only be established, but there must also be some means to determine conformance. Some surveillance of supplies and certification to the consumers is, therefore, necessary.

4) *Registry*: There will have to be a central registry which will compile and keep alive a master record of biological materials in general demand. It is to receive periodic reports on sources, availability, volume of breeding, gradual changes in strains, new breeds, anticipated production and demand, etc.

5) *Information*: Data compiled by the registry should be made available as widely as possible to potential producers and consumers. Consumers should be able to turn to the central registry to find out when, where, and how to obtain given types of animals or animal products.

6) *Supply mechanisms*: Coordination should be attempted in all common measures to improve the mechanics of rearing, shipping, and protecting animal stocks, including adequate attention to animal welfare.

The committee, composed of representatives of academic institutions, government, industry and trade organizations, and including specialists in genetics, breeding, nutrition, parasitism, distribution and care of animals, developed a systematic and comprehensive plan. To implement this, an Institute of Animal Resources was established as a subunit within the Division, and assigned to the administrative sphere of the American Institute of Biological Sciences. O. N. Eaton, of the Bureau of Animal Industry, U. S. D. A., and himself a geneticist, has been appointed Executive Secretary.

The objectives of the Institute are:

1) To survey and put on record the existing sources of production and supply of animal material used in biological and medical research, assay, and testing.

2) To coordinate and organize this information in such a way that it can and will be available for distribution to individuals and institutions engaged in such assay, testing, and research.

3) To develop and establish reasonably scientific standards for the production, nutrition, hygiene, and shipment of such animals.

4) To take such steps as may be necessary to preserve the continuation of the various genetic strains or stocks of such material available now, or in the future.

5) To study the need for such material, both under peacetime conditions, and in the event of a possible national emergency, and to take steps to organize and have in readiness the personnel and other facilities for such extension of activity as may be necessary.

6) To explore and expedite international exchange of animal stocks of special characteristics and significance which are not available in this country.

Mainly concerned are all of those organizations and establishments engaged in biological, medical, agricultural, and public health research and testing. These include the testing laboratories of government (federal, state, municipal), of industry, and of educational institutions; foundations and agencies supporting biological, medical, and agricultural research; animal breeders; biological supply houses, and others.

SAMUEL L. MEYER
Executive Director, AIBS

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

All correspondence should be sent to SCIENCE, 1515 Massachusetts Ave., N.W., Washington 5, D. C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50. Special rates to members of the AAAS.

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Avenues of Service

Bernard E. Schaar[1]

Schaar and Company, Chicago, Illinois

ONE OF THE PRIMARY PURPOSES of the American Institute of Chemists is to enhance the prestige of the profession and to extend its influence and usefulness. In this it has eminently justified its existence. An outstanding service has also been rendered by the Chicago Section of the American Chemical Society to individual chemists and to the community. It is patent that these two organizations, at least, are keenly aware of their responsibilities. In addition to direct benefits to their members, there is a tacit acceptance of duty beyond the purely professional.

That is as it should be. For example, we are all aware of one item—that chemists and all others who have been privileged to get a professional or academic education were subsidized by their alma maters, whether state-supported or privately endowed, to the extent of the greater part of the cost of their training, despite the current high tuition fees. Some are content to accept this gift and let it go at that; others feel that they must do something in return, over and above good performance in the occupation for which their training fitted them. Salaries in most of the technical professions being what they are, only the exceptional few can repay in kind, that is, contribute financially to the support of their favorite institutions. All, however, can show appreciation by some sort of public or community service.

One can travel along many avenues. Regardless of the ones that are chosen, this type of work is its own reward. One gives and receives at the same time. Orchids may be few, but there is real compensation in the personal satisfaction that comes from engaging in this type of activity. Most of the former Honor Scroll recipients have been outstanding in this respect in addition to their technical achievements.

The first and most easily accessible path is the professional society to which one belongs. Here numerous jobs and committees are perennially open to all who choose to enter. The obligation is primarily to the profession—to do some of the things that will keep the society functioning, that will strengthen it and broaden its usefulness, but that will also make it a constructive force in the community. Our professional societies are in existence because they have been kept alive and useful by the work of others who preceded us. We can do no less for those who will follow. We are merely temporary custodians, links in the chain of continuity.

[1]The Chicago Chapter of the American Institute of Chemists awarded its 1952 Honor Scroll to Mr. Schaar in recognition of his services to the chemical profession and to the community at large. This paper is based on Mr. Schaar's address at the testimonial Award Dinner on Oct. 10, 1952.

Occasionally the long-range results and the satisfaction far outweigh the immediate substantiality of the service, as those know who serve on employment committees, particularly when no jobs are available. I know several chemists, now in important positions, who would have left the profession had it not been for the friendly counseling of some member of an employment committee, even though at that time, no help could be given to place them.

Some societies have well-organized public relations committees, with registers of talks that can be given by their members. The radio is used increasingly to publicize topics related to science. The A.C.S. News Service is preeminent in publicizing chemists and chemistry. Walter Murphy has had a number of excellent editorials on public relations in *Chemical and Engineering News*. Then there are the papers presented at the last A.I.C. annual meeting on "Public Relations for the Chemist," some of which were published in *The Chemist*. The Engineering Joint Council, a cooperative venture of the five principal engineering societies, has public relations as one of its most important activities. It is currently planning to take in twelve more societies. THE SCIENTIFIC MONTHLY of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE sponsors a series of radio broadcasts of scientific material and invites participation by universities and individuals. Science News Service and popular science magazines also are factors in public relations.

The most extensive program to publicize science that I know was the series of broadcasts during intermissions of the Sunday Concerts of the New York Philharmonic Symphony, sponsored by the United States Rubber Company. Starting in 1943, there were about eighty talks by top-notch scientists, including many Nobel Prize winners. Subjects ranged from the structure of atoms to the exploration of space, and there were also a few talks by social scientists. The whole series is available in book form under the title *The Scientists Speak*.

Much more is being done along this line, but enough has been mentioned to indicate the inexhaustible opportunities for service. Public relations work of this nature unquestionably is of great value in informing the public about the accomplishments of scientists and engineers. It will increase their prestige, and therefore, their usefulness. In the main the substance of radio talks, public lectures, or popular science articles is factual and pertains to a single topic on which the speaker or writer is expert. Although informative, they usually are not designed to coordinate the particular subject with a more basic consideration of sci-

entific method or of the impact of science on society.

Another type of publicity for science, dinning the ears of listeners daily, is a disservice to science and scientists. The "science proves" theme and pseudo-scientific statements conjured up by inspired ad writers to sell everything imaginable tend to give people a totally false impression of scientists and their work. It is unconstructive exploitation of the word "science." If chemists could be instrumental in putting this type of advertising on a higher plane, I am sure the profession of chemistry would reap some benefit, to say nothing about relief to a long-suffering public.

The technical society councils that have been organized in all parts of the country offer many opportunities for public relations work. The potentiality for serving their communities and their constituent societies is great. Performance has lagged in some areas, principally because funds for most effective operation have not been available. Councils are designed so that the societies can cooperate in pursuing objectives beyond the scope or means of the individual societies. The combined memberships of the societies is a much greater force for community activity than any one society can command. Councils can become the overall agencies in spanning the gap between the technical programs of the societies and their relation to the community. As a medium for informing the public on technical matters and in creating opportunities for greater participation of technical men in public affairs, they offer a broad avenue for service.

Outside his professional organizations, in the community at large, precisely the same opportunities for public service exist for the scientist and engineer as for any other citizen. Every "cause" under the sun has one or more organizations to further its aims. It is not difficult to be active in these, to serve on their boards or committees. The respect paid the scientist for creditable service in this area in a measure is extended by his associates to his whole profession, and elevates its status.

There is increasing awareness that the changes in our mode of life and in our international relations, resulting from scientific discoveries and their practical applications, demand a greater measure of participation in public affairs than scientists and engineers formerly considered to be within their province. The lack of authentic information on scientific and technological developments and their social concomitants that mold our life and continually change it makes it imperative that people be better informed. Information is necessary not only that their judgments may be more soundly grounded, but also that the continued support of fundamental research by the public, through taxation and private endowments—without which our technological advances will wither—may be assured. Without such information, it is understandable why scientists find it necessary to be on the defensive with respect to their place in the civilized world.

World War I found our chemists feverishly developing poison gases and block busters, and our engineers, bombing planes. World War II saw the development of bacterial warfare and the birth of the atomic bomb. Hydrogen bombs and other weapons of destruction too horrible to contemplate are on the way. True, the Germans in World War I, after their first attempts, were deterred from using poison gases by the threat of retaliation in kind. Bacteria have never been broadcast and only two atomic bombs were dropped as weapons. But these things are associated in the minds of people with scientists and engineers and have engendered a sense of fear for what may be in the offing and a mistrust of the professions that produce such things.

Regardless of how much we point with pride to the good things that flow, without end, from scientific and technological developments, the fear and mistrust, and the deliberate antagonism and opposition to verified scientific findings, remain. Evidences of this are to be found in such things as the opposition to the use of chemicals in foods revealed in the hearings of a Congressional Committee; the propaganda against the use of fertilizers by certain groups of plant cultists; the opposition to fluoridation of water; the restrictions on the free publication of scientific research which in some cases go far beyond security requirements; the irresponsible character assassinations; the loyalty oaths and guilt by association verdicts; the refusal of passports and visas to certain scientists;[2] the horoscopes in daily newspapers; the many monthly magazines on astrology; the misplaced love and tenderness of those who oppose animal experimentation; the opposition to flood control; the deliberate falsification of the aims of those who want adequate medical care for everybody; antisemitism, Jim Crow laws, discrimination in employment opportunities and other denials of civil liberties—to mention only a few things. I know this sounds like a Jeremiad, but, if you will bear with me, I think you will find that I am not a dispenser of gloom.

There is nothing particularly new about this, except the nature of the things that are singled out for attack or claim the support of the misinformed. You will permit me to refer to an editorial of mine in the *Chemical Bulletin* in 1925, "The Significance of Dayton," which was written during the Scopes trial in Dayton, Tennessee: "Anti-evolution laws are but one phase of a narrow, illiberal, reactionary spirit pervading the country, which has already evidenced itself in the Eighteenth Amendment, the Ku Klux Klan, the censorship of literature and other movements of similar character. This spirit is perhaps the expression of a well-organized minority rather than the carefully thought out will of the country as a whole. The only solution is a wider distribution of knowledge."

It is extremely encouraging to note that the bitter controversy between science and religion over the theory of evolution has largely abated; the Eighteenth

[2] Our visa and passport policy is of such importance that the *Bulletin of the Atomic Scientists* devoted the entire October 1952 issue to it.

Amendment has been nullified; the Ku Klux Klan, except for occasional flare-ups, is not the sinister menace it once was. True, other movements, organizations, and restrictive laws have succeeded them. Many hold a far greater threat to our liberties. But we can take heart in the thought that since these once powerful forces have been curbed, it should be possible to counteract, and eventually replace with more constructive movements, the current unscientific or anti-scientific, and in some cases, undemocratic and un-American trends that are rampant today.

For the most part these things have had consideration by scientists in one field or another. Most of them are rooted in ignorance, misinformation, or prejudice. Some are in the realm of politics; others in the attitudes, opinions, and practices of individuals in their daily lives. Some are deliberately fostered by amoral persons with their own axes to grind, regardless of the resulting harm; others, by well-intentioned people motivated by irrational fears.

These seemingly unrelated items are evidences of the failure of our educational system to prepare people so that they will not become the ready followers of equally misinformed or misguided people. It is also evidence of the failure of scientists to put their case across so that non-scientists can have some insight into what they have discovered, what they are doing now, and how they do it, and what the ultimate goals are.

It is obvious that the groundwork for more rational thinking must be laid long before the individual reaches adulthood. For most people the die of intelligent citizenship is cast in the public school, and all are adversely affected by the shortcomings of our educational system.

As Hutchins and others indicate, an important factor is to be found in the emphasis placed on the acquisition of factual or practical knowledge throughout our primary and secondary educational system. It even extends into the college and university. In some cases it results in the almost total exclusion of cultural instruction, including the sciences, physical as well as social. Greater familiarity with such subjects unquestionably would prepare adults for clearer thinking. This condition is closely linked with the great shortage of teachers, particularly those with adequate training in the sciences. In turn, this shortage reflects the current unattractiveness of the teaching profession as compared with opportunities in industry. Consideration of means to turn the tide is well within the province of all technically trained persons.

The present lapse is anachronistic. At a time when scientific findings and technological developments are high and constantly rising; when they have made a standard of living in this country undreamed of a half century ago and give promise of a better order everywhere, we find in many quarters, in and out of government, acts and movements which will hinder or even prevent further advance. It is more in keeping with the restrictions and taboos of centuries past that throttled thinkers like Roger Bacon and nearly succeeded with Galileo; or with the verdict, during the French Revolution, that France had no need for men of science that resulted in the guillotining of Lavoisier, the father of modern chemistry. The tendency is in the direction of stifling independent ideas, of forcing uniformity of thought, of stamping out opposition. Unrestrained, it could lead to authoritarian diets with respect to scientific investigation such as we are witnessing in Russia at this time. A free and informed public there would not countenance such dogmatism.

It would be well to keep in mind that progress in any endeavor does not proceed along a straight line, rising smoothly upward until the goal is reached. There are ups and downs, peaks and troughs, with each succeeding peak usually a little higher than the preceding. At present we seem to be in the trough of one of those recurring cycles of intellectual retrogression that have periodically afflicted the world. Depressing as it is, this trough does not seem to be as deep as the last one with its Klans, its Palmer raids, or its Hitlers. And there is every reason to believe, that, when we pull out of it, the peak of the upswing will exceed the previous one.

In the 1951 Arthur Dehon Little Memorial Lecture at the Massachusetts Institute of Technology on "Science and Democracy," Sir Henry Tizard had this to say: "The trouble is that people who hate are much more articulate than people who love, and so make more noise in the world; and unfortunately, they are often infected in the highest degree with the desire to dominate their fellowmen. If the democratic countries combine firmness and strength with patience and tolerance, I see no reason for being pessimistic about the future."

Our democracy does have the inherent vitality to recover from these sieges of intellectual atavism, whether the attack is from the extreme left or the extreme right. Hope springs eternal. But hope alone is sterile and unproductive of change. Dynamic action must take the place of wishful thinking or scornful despair. We need more scientists like Pauling, Condon, Shapley, and Mather, who have the courage to speak out, even under attack.

Here are many avenues of service to his country, to his profession, and to himself, that can be followed by chemists and other technical men. They are fertile fields for those qualified to cultivate them.

Early in my career I ran squarely into a case of contempt for scientific procedures. A building was being erected by the company that employed me. I was instructed to sample and test each car of cement as it arrived and report the result to the foreman on the job before he used it. When I made my first report, I found the cement was being used without waiting for the test. The foreman explained that he had run out of tested cement and had to use it untested to keep his men busy. Since the test was all right, no harm was done, so I merely admonished him against using subsequent shipments until I reported. The next

day the same thing happened. When I arrived on the third day, the foreman became somewhat exasperated and rather heatedly expounded his infallible method of testing cement. He said—"I don't have to wait for your report to find out if a cement is good. I can tell just by feeling it. Why, I don't even have to feel it. I can kick the outside of a bag and tell whether it is good or bad!" Although foremen since those days have traveled far in their faith in laboratory tests, on other levels of acceptance of scientific findings we seem still to be "kicking the bag."

The outstanding example of awareness of an obligation to society by scientists was the successful campaign of the atomic scientists to educate Congress and the public on the dire implications of the atomic bomb. The result, as you know, was the Atomic Energy Commission and our proposal to the United Nations for an international body to control fissionable materials. It was a remarkable achievement that cannot be recalled too frequently. It reveals clearly what can be done when scientists leave their laboratories to perform, as scientists, a public service.

Articles on the social obligations of scientists are appearing in scientific journals with increasing frequency. The titles of some of these are in themselves quite illuminating. A recent symposium in the *Bulletin of the Atomic Scientists* will serve to illustrate the tenor of the thinking. It is called "The Duty of the Scientist in Society" and consists of the following articles: "Scientists are Quite Ordinary Folks" by A. V. Hill, 1922 Nobel Prize recipient in physiology, and who, to back up his thesis, was a member of the House of Commons for five years; "Science is Essentially Social" by Phillip Morrison, professor of physics at Cornell; "Working For a Society Where Science Can Thrive" by N. F. Mott, professor of physics, University of Bristol; "Scientists Have a Duty In Society" by Murray S. Levine of Oak Ridge; and "The Responsibilities of Scientists" by Lord Boyd Orr, a British authority on food and agriculture. A recent article in SCIENCE by Kirtley Mather is titled "The Problem of Antiscientific Trends Today." A great many more could be cited. I feel more at home today among these titles than I did 20 years ago when, as retiring chairman of the Chicago Section, the subject of my address was "Scientific Method and Human Relations."

Articles such as these are stimulating and might be provocative of action by other scientists who happen to read them, but they fall far short of maximum effectiveness because of the small and specialized audiences that they reach.

I should like to say a word along a somewhat different line of service which though seemingly of limited application, actually is of substantial benefit to chemists as individuals and to the chemical profession. As a prelude, I am reminded of the story of three hod carriers working on a building, each filling his hod and carrying it to the bricklayers or masons. When asked what they were doing, the first one replied: "I am carrying mortar;" the second one answered, "I am carrying bricks;" but the third proudly said, "I am building a cathedral."

Young chemists just starting their careers also are faced with the necessity of evaluating their work. Those who have been imbued with the importance of their profession, first by their professors and later by their superiors in industry, will view their immediate tasks in a manner comparable to the third hod-carrier. They will know that, even though the things they are doing are relatively simple, they none-the-less are contributing, with others, to the perfection of something that is building our civilization. All are not geniuses, but all can and should have just such an appreciation of the importance of their work and their profession. It may or may not make them better chemists. It certainly will increase their self-respect, make them better citizens, and make it possible for them to live with themselves with greater satisfaction and dignity. In proportion as the public is impressed with the worth of an individual chemist and with what he is able to transmit about the role of his profession in our civilization, so will our professional status rise. The same goes for young engineers.

Chemistry touches life at every point whether one knows any chemistry or not. Essentially all life is chemistry, plus a little physics and a bewildering amount of organization and cooperation on the microscopic level of the living cell. The well-being of every one is dependent upon chemistry. I think it is more important for non-chemists to appreciate this than it is for them to know the gas laws, the ionic theory, or how to balance equations. Not that it will do them any harm to know these things. They even might be a source of considerable interest and pleasure. However, it seems to me that in courses intended for non-chemists, if less emphasis were placed on the technicalities of chemistry and more on its social meanings, its universality, and its scientific method of discovering new facts, there would be more general understanding of the humanizing role of chemistry, and less antagonism to scientists.

Such a course would justify itself, I think, if it served no other purpose than to enable one to get a glimpse of the hidden beauty of the natural world in which we live, or to view with greater humility the mightiest works of men. Even those who intend to become chemists might well profit from this type of presentation. To those of us who love chemistry as a science and as a culture, the revulsion of feeling that so many have toward it, is, ipso facto, indicative that something was missing in the way it was presented to them.

I think we can go even farther. In addition to other reasons given for the current shortage of chemists and chemical engineers, we might find that introductory chemistry courses in high school and college actually kill the desire of most students to select chemistry as a career, instead of whetting their appetites for more. I know much thought is being given to the content of

such courses. Some unquestionably do make incipient chemists, but not enough, otherwise the shortage would not be so acute. Only the most dedicated survive. This is an avenue of service that can be followed best by those in the business of teaching, but chemists in industry also might have some thoughts on the subject that could be helpful.

The satisfaction one derives from serving along any avenue has been mentioned. Unfortunately, there is another side to the picture. Serving is not all beer and skittles. Disappointments and frustrations are also part of the game. One's motives and good intentions even may be questioned occasionally. All of this must be taken in stride. One must continue to work for the realization of the ends which were thought good, so long as there is some measure of progress toward their attainment. Differences of opinion with respect to procedures constantly arise. One cannot always be right. Others equally sincere and with comparable ability may have the better solutions. Frequently organizations which gave great promise at their inception fail to function or to grow as planned. Where they fail, others with similar programs, profiting from earlier errors, might succeed. Discouragement has no place in the curricula of those whose sights are set high. But there can be no compromise with principles. When the issues in a particular organization demand their sacrifice, get out and go on to something else.

The avenues for service are legion. It is only necessary to make a choice, to select those which our inclinations and ability permit us to follow. A whole gamut of organizations is spread before us, offering an endless variety of challenging, of rewarding paths to follow.

Science does not have the answer to all human problems. Neither are scientists necessarily the best qualified to attack them. In a world increasingly dependent upon scientific findings for many, although not all of the good things of life, the special competence of scientists lies in helping people to acquire their ability, and their will, to unshackle their minds when attacking new problems in their field. The all-important issue today, the one that overshadows everything of a political or economic nature is the elimination of war. In this, scientists have no ready answer. In this atomic age, the attainment of peace is a new and different problem from what it was in the past. Each of us, in his way, had better give thought to the possibility of helping to achieve it. That it is receiving such consideration by some scientists is indicated by a document prepared by the National Research Council Committee on Unesco and the Engineering Joint Council for the Third National Conference of the U. S. National Commission for Unesco. Its assigned topic was "The Opportunities for Scientists and Engineers to Contribute to Peace through the United Nations System."

I would like to close with a quotation from the article by Hill previously mentioned. It expresses more tersely and in clearer language than I can command, the gist of what I have been trying to say. Hill wrote: "Science is in the best sense, I believe, key to the whole culture of our modern world, that general culture which exists in its different and presently contesting forms along the Potomac, the Volga, and the Yangtze. But scientists are only the special professional exponents of their way. What will count in the end is not their acts alone nor their understanding of their duties, however deep, but the degree to which the general ends of science gain adherence among the people as a whole."

In the final analysis that is the goal toward which all avenues of service by scientists and engineers should lead.

News and Notes

Harvard and the Fifth Amendment

THE appeal to the Fifth Amendment by witnesses before Congressional committees of investigation, in order to escape answering questions regarding either their own past relations with the Communist Party or those of associates, has raised grave issues of academic freedom and responsibility and of professional conduct. Some professors have been dismissed or suspended outright; in other cases the administration and trustees have acted contrary to the recommendations of the faculty. In contrast, other institutions have adhered to some measure of due process (see the case of Byron T. Darling, Associate Professor of Physics at Ohio State University, in SCIENCE, April 24, 1953, p. 445). The latest chapter in this history has been written by Harvard University, whose stout defense in times past of intellectual freedom and the principle of personal responsibility makes its handling of this problem of particular note.

The following is a verbatim transcription of a Harvard press release on the matter:

> The Harvard Corporation has completed its study of the activities of three officers of instruction.
>
> Here is a summary of its findings:
>
> 1. Associate Professor Wendell H. Furry's actions during membership in the Communist Party included "grave misconduct."
>
> Dr. Furry will not be dismissed, because the "grave misconduct" took place nine years ago "in a very different climate of political opinion."
>
> The finding of "grave misconduct" will remain in full effect for three years. If at any time during that period, either because of Dr. Furry's future conduct or because of new evidence as to his past conduct, the Corporation should deem it to be for the best interests of the University to remove him, he will be removed.

After the three year period, Dr. Furry will not be subject to removal solely on the basis of the present finding of "grave misconduct." When the three years are ended, he may be removed only after new proceedings.

(Under University Statutes, a finding of "grave misconduct or neglect of duty" is necessary for dismissal.)

2. Dr. Furry, Assistant Professor Helen Deane Markham and Teaching Fellow Leon J. Kamin were guilty of misconduct, but not "grave misconduct," in using the Fifth Amendment to avoid answering questions of Congressional committees. Neither Dr. Markham nor Mr. Kamin will be dismissed.

The Corporation deplored the use of the Fifth Amendment by faculty members, saying:

"In the first place, we think full and candid testimony by all teachers would disclose that there is little Communist activity today in educational institutions. But more important, the use of the Fifth Amendment is in our view entirely inconsistent with the candor to be expected of one devoted to the pursuit of truth."

3. Dr. Furry dropped out of the Communist Party in 1947, Mr. Kamin dropped out of the Party in 1950, before he became a Teaching Fellow, and Dr. Markham is not, and never has been, a member of the Communist Party.

4. None of them has given a Communist slant to teaching, or has sought to influence the political thinking of students.

As to present membership in the Communist Party, the Corporation said:

"We would regard with the gravest concern the presence on our teaching staff today of a person who is now under the domination of the Communist Party. We think membership in the Communist Party by a faculty member today, with its usual concomitant of secret domination by the Party, goes beyond the realm of his political beliefs and associations. It cuts to the core of his ability to perform his duties with independence of thought and judgment. By the same token, it is beyond the scope of academic freedom. In the absence of extraordinary circumstances, we regard present membership in the Communist Party by a member of our faculty as grave misconduct, justifying removal."

The Corporation added:

"Since we are not conducting a criminal trial, we will not shut our eyes to the inference of guilt which the use of the Fifth Amendment creates as a matter of common sense. Hence, the use of the Fifth Amendment by a member of our teaching staff, within the critical field of his possible domination by the Communist Party, makes it necessary in our judgment for us to inquire into the full facts. We regard it as misconduct, though not necessarily grave misconduct."

In its proceedings, the Corporation considered each of the three cases separately. The Corporation studied the transcript of Congressional committee hearings. A special committee interviewed the individual and his faculty colleagues. Each individual then had a hearing before the full Corporation. Throughout the proceedings, the Corporation discussed the case fully with the Faculty Advisory Committee appointed last January.

Another case—that of Dr. Daniel Fine, Teaching Fellow in Medicine—remains to be decided. Dr. Fine also is on the staff of the Peter Bent Brigham Hospital, and his case is being considered in cooperation with the Hospital trustees.

Editorial Note: SCIENCE *will endeavor to report fully all news of this kind in as objective a manner as possible. It is the belief of the members of the Editorial Board that scientists throughout the nation and abroad should be fully informed of all important developments, social, political, or economic, that affect science and scientists.*

New President at University of Pennsylvania

GAYLORD P. HARNWELL, who has been Chairman of the Department of Physics at the University of Pennsylvania for the past 14 years, has been elected president of the institution. He succeeds Harold E. Stassen, who relinquished the post to become director of the Mutual Security Agency. When he takes office on July 1, Dr. Harnwell will be the first physicist to head the University in its 212-year history. Graduate of Haverford College in 1924, he studied at Cambridge University in 1924–25, and later at Princeton University, where he received the degree of Doctor of Philosophy in 1927. He was a National Research Council Fellow at the California Institute of Technology in 1927–28. In 1928 he returned to Princeton to teach physics, serving successively as an assistant professor and an associate professor.

His association with the University of Pennsylvania faculty began in 1938 when he was appointed professor of physics and director of the Randal Morgan Laboratory of Physics at Pennsylvania. Besides holding the Mary Amanda Wood Professorship of Physics and serving as Director of the Morgan Laboratory and Chairman of the Physics Department, he also has been Professor of Radiologic Physics in the University's Graduate School of Medicine. His research work in nuclear physics, discharge of gases, and acoustics is widely known. From 1942 to 1946 he served in the position of Director of the University of California Division of War Research, U.S. Navy Radio and Sound Laboratory, San Diego, Calif. For his services in that capacity Dr. Harnwell was awarded the Medal for Merit, accompanied by a citation in which he was credited with having been "directly responsible for the severing by submarines of the last sea route from Japan to the mainland of Asia by his intelligent and constant supervision of the work of preparing for the United States Navy certain special weapons and devices."

At the University of Pennsylvania after the war, Dr. Harnwell reorganized the instructional and research programs in physics in recognition of the wartime developments in that field. The schedule of elementary and graduate courses in physics for engineering students was extended by the inclusion of a one-year course in atomic physics, and the undergraduate courses were changed primarily through the introduction of courses dealing with modern atomic and nuclear physics and the inclusion of additional laboratory work in all undergraduate courses. Changes likewise were made in the courses at the graduate level. Courses of theoretical nature in modern quantum mechanics were introduced, as well as experimental courses in modern laboratory techniques. In addition, a series of courses in two fields of particular specialization—the physics of solids and nuclear physics—were introduced. There was a steady increase in the facilities for research in physics at the University, an outstanding addition being a $200,000 betatron laboratory, or "atom smasher," which was erected in 1948 on the University campus. Dr. Harnwell has played a large part in planning the facilities for instruction and research to be provided in the University's new $2,700,000 building for physics, mathematics, and astronomy, which is now being erected. In addition to his University connections, Dr. Harnwell is chairman of the Ordnance Committee of the Research and Development Board of the Department of Defense and chairman of the Committee on Undersea Warfare of the National Research Council. He also serves on the Advisory Board of the United States Naval

Ordnance Laboratory, Silver Spring, Md., the Advisory Committee of the Ordnance Corps of the Department of the Army, and the Board and Executive Committee of the American Institute of Physics. For a number of years he has been consulting editor of the "International Series in Pure and Applied Physics," published by the McGraw-Hill Book Company, Inc.; editor of *The Review of Scientific Instruments*, and editorial director of *Physics Today*, the latter two being publications of the American Institute of Physics. He is the author of *Principles of Electricity and Electromagnetism*, published in 1929, and the co-author, with John J. Liningood, of *Experimental Atomic Physics*, published in 1936. He is a member of Phi Beta Kappa and a Fellow of the American Physical Society.

In unanimously nominating Dr. Harnwell for the presidency of the University, the Trustees followed a recommendation made by a committee of Trustees appointed to explore the field of potential nominees for that office. A faculty committee, headed by Dr. Alexander H. Frey, Professor of Law, was appointed by the University Senate, a faculty organization, to cooperate with the trustees in an advisory capacity.

Scientists in the News

Loyal V. Bewley, Head of the Department of Electrical Engineering at Lehigh University, received the R. R. and E. C. Hillman award of $1000 given annually "to a member of the faculty who is deemed to have done most toward advancing the interests of the university."

Edmund J. Blau has joined the Organic Coatings Section of the National Bureau of Standards Chemistry Division. A specialist in physical chemistry, Dr. Blau will investigate the drying process in paint and related films and the physical and chemical changes occurring during film formation.

C. West Churchman has been appointed Professor of Engineering Administration and Director of the Operations Research Group at Case Institute of Technology, Cleveland, Ohio.

Ainsley H. Diamond, Chief of the Mathematics Branch, U.S. Army Office of Ordnance Research, has been named Professor of Mathematics at Stevens Institute of Technology. Professor Diamond will assume his new post next September.

William J. Farrisee, Dean of Students at Clarkson College of Technology, Potsdam, N. Y., has been appointed Associate Dean and Professor of Civil Engineering at Stevens Institute of Technology. Dr. Farrisee will assume his new duties this summer.

Edward I. Feigon, formerly research engineer with Tufts College, Department of Systems Analysis, has been appointed chemist in charge of research and development for Kitchen Art Foods, Inc., Chicago.

Solomon Lefschetz, Chairman of the Princeton University Department of Mathematics, will retire July 1 and will be succeeded by **Albert W. Tucker,** a member of the Princeton faculty and leader of the logistics project. Dr. Lefschetz will continue to work at Princeton on nonlinear differential equations, a study on which he has been employed for five years for the Office of Naval Research.

Milton Orchin has been appointed Associate Professor of Applied Science at the University of Cincinnati. For the past 10 years Dr. Orchin has been chief of the organic chemistry section, research and development branch of the office of synthetic liquid fuels, Bureau of Mines, Pittsburgh.

Raymond E. Ovelgonne has joined the staff of Eli Lilly and Company as a biochemist.

Clarence V. Reichelt has been appointed Assistant Director of Engineering for Chas Pfizer & Co., Inc. Mr. Reichelt, who assumes his new duties immediately, will make his headquarters at the company's main offices in Brooklyn. **Gerald L. Eble,** who has been serving as assistant to Mr. Reichelt, will succeed him as Head of the Engineering Department at Pfizer's Vigo Plant in Terre Haute, Indiana.

Albert Schatz, co-discoverer of streptomycin, has been appointed director of the new Research Laboratory of the National Agricultural College, Farm School, Pa.

Joseph E. Smadel of the Walter Reed Army Medical Center has been awarded the Howard T. Ricketts Medal of the University of Chicago, in recognition of his discovery of the beneficial effects of antibiotic drugs in the treatment of typhus fever.

Edward L. Tatum of Stanford University has received the Annual Award for Distinguished Service in Chemistry presented by the Maryland Section of the American Chemical Society.

Oswald Tippo, Chairman of the University of Illinois Botany Department, has been appointed Dean of the Graduate College, effective September 1. In addition to his new duties, he will continue as head of the Botany Department.

J. Harold Wayland, Associate Professor of Applied Mechanics at California Institute of Technology, will spend the 1953–54 academic year in Europe on the John Simon Guggenheim Fellowship which he has just been awarded. Most of his work will be done at the University of Strasbourg, but he will visit other institutions. He will investigate engineering aspects of the technique of fluid flow visualization by streaming double refraction.

Maynard Owen Williams, chief of the foreign editorial staff of the National Geographic Society since 1930, retired on June 1 after 34 years of service with National Geographic. His travels for the Society have averaged some 25,000 miles a year for over 25 years.

Education

The Special Training Division of **Oak Ridge Institute of Nuclear Studies** will offer an advanced course, Sept. 14–25, covering clinical applications of radioisotopes. This is the second in a series concerned with medical uses of isotopes. Participation is limited essentially to physicians having clinical experience with radioisotopes. Additional information can be obtained from the Special Training Division of the Institute, P. O. Box 117, Oak Ridge, Tenn.

The Department of Geography, **University of California** at Los Angeles, will conduct its annual Field Camp June 29–Aug. 7. R. F. Logan and C. H. MacFadden will be in charge and inquiries should be sent to the department. The first week will be reconnaissance study in the Mojave Desert, followed by four weeks of field work in Ventura County. During the final week reconnaissance studies will be carried on in two other contrasting areas.

The **Woods Hole Oceanographic Institution** is offering a course of lectures on Physical Oceanography by R. S. Arthur in the Old Lecture Hall, Marine Biological Laboratory, Aug. 3–Sept. 4. A comprehensive elementary account of the principles of oceanography will be presented in these free public lectures, which carry no official college credit.

In the Laboratories

Among speakers at the **Cathode Ray Sterilization Symposium** held May 21 in conjunction with the opening of a new Cathode Ray Sterilization Laboratory by General Electric at Milwaukee, Wis., were W. M. Urbain of Swift and Company, G. M. Dack of the University of Chicago, and E. J. Lawton and W. D. Bellamy of the GE Research Laboratory at Schenectady.

A plant for manufacturing phenol from air and oil, dedicated May 27 in Montreal East, Quebec, is designed to use a process developed in this country by the **Hercules Powder Company.** It is owned and is to be operated by B.A.–Shawinigan Ltd., under license from Hercules and from the Distillers Company Ltd., of England. The Shawinigan plant is designed around a process which is the culmination of more than 15 years of fundamental research by Hercules, on the oxidation of terpenes, *p*-cymene, and cumene.

A small atomic pile, contained in a cube of graphite measuring only five feet on a side, has been placed in operation as a research tool at the **Knolls Atomic Power Laboratory,** which is operated by the General Electric Company for the Atomic Energy Commission. The new low-power nuclear reactor appears not much larger than a bank of four ordinary office filing cabinets. The device was developed by a team of scientists, H. B. Stewart, E. G. LaViolette, C. L. McClelland, G. B. Bavin, and T. M. Synder.

The John Thompson Dorrance Building, new home of the Departments of Biology and of Food Technology at **Massachusetts Institute of Technology** will be dedicated the morning of June 25. Detlev W. Bro[illegible] will deliver the dedication address. Two scientif[illegible] symposia, "Perspectives in Quantitative Biology" and "Global Concepts of Food Technology," will be held in the afternoon. The Campbell Soup Company is the principal donor of the new building. It honors one of the company's former presidents who was an MIT alumnus of the class of 1895.

Meetings and Elections

The **Aero Medical Association** has installed the following new officers: president, Bertram Groesbeck, Jr., and president-elect, Otis O. Benson, Jr., Vice presidents elected were Kenneth E. Dowd, Andre Allard, Trajano Bernardo, and E. O. Errebo-Knudson. M. S. White, Seymour Fisk, and Edward J. Baldes were chosen to serve on the Executive Council.

A European Conference of Chemical Engineering, to be sponsored by the **Dechema** (Deutsche Gesellschaft für chemisches Apparatewesen) and the Société de Chimie Industrielle, will be held in Paris, opening June 22, in connection with the 2nd Salon de la Chimie and the 26th Congrès International de Chimie Industrielle. This conference will also form the program of lectures of the Annual General Meeting of the Dechema for 1953. Dechema Institute, at Frankfurt am Main, will open, on July 3, a new information center for the chemical apparatus and equipment industries, with the object of gathering for display chemical apparatus and equipment, metering and control apparatus, materials used in construction of chemical apparatus, and new raw materials for use in the industry.

The **Fourth Annual Biological Symposium** will be held at the University of Michigan, July 6–17, sponsored jointly by the Division of Biological Sciences and the Michigan Memorial-Phoenix Project. Speakers will include G. W. Beadle, California Institute of Technology, Roberts Rugh, Columbia University, A. H. Doermann, Oak Ridge National Laboratory, and Henry Eyring, University of Utah. Subjects will cover such topics as the effect of radiation on mechanisms of heredity, on gene function, and on human growth and development.

The **Georgia Academy of Science** held its 1953 Annual Meeting at Mercer University, Macon, on April 24–25. Fifty-six papers were presented, and a symposium on cerebral palsy was held by the Psychology and Medicine Section. Officers for 1953 are: F. Homer Bell, president; W. A. Calder, vice president; and Lane Mitchell, council member for three years.

North American Philips Company, Inc., and its western dealers will hold the First Western X-ray Diffraction School at the Sir Francis Drake Hotel,

San Francisco, August 24–28. The new school will repeat on the west coast the annual program which has been successful in the New York territory for the past seven years. Sessions will be devoted to lectures and laboratory demonstrations using the latest types of equipment.

New officers of the **Society of American Bacteriologists** include: president, G. M. Dack, University of Chicago; vice president, C. B. Van Niel, Hopkins Marine Station, Pacific Grove, Calif.; secretary-treasurer, J. H. Bailey, Sterling-Winthrop Research Institute; business manager, F. C. Harwood, Baltimore, Md. Councilors-at-large are Sara E. Branham, C. H. Werkman, J. E. Blair, and W. H. Ewing.

A **Solar Energy Conference**, sponsored by the National Science Foundation and the University of Wisconsin, will be held at the University Sept. 12–14. About 30 physical scientists and engineers from the U. S. and abroad will meet to assess present knowledge of solar energy utilization and to point out needed areas for basic research. The Wisconsin meeting will cover aspects of solar energy utilization not discussed at a previous conference held last fall in Gatlinburg, Tenn. Biological methods, including research in photosynthesis, were discussed at that time. At Madison the conference will discuss conversion into other forms of energy, such as electricity and heat; storage of solar energy in various ways including chemical reactions; and the use of fluid-solid phase changes and crystal alterations as mechanisms for the storing of energy. The findings and recommendations of the conference will be published. The committee to plan the conference includes Farrington Daniels, chairman; Werner A. Baum, F. G. Brickwedde, Hoyt C. Hottel, Everett D. Howe, and Ralph A. Morgen.

Miscellaneous

A Joint United States-Canadian program to investigate the most probable source of Arctic ice islands is now under way. The expedition is sponsored by the **Canadian Defense Research Board**, the **Geological Survey of Canada**, the **Air Research and Development Command** of the U.S. Air Force and the **Snow, Ice and Permafrost Establishment** of the U.S. Army. Two Canadian scientists, Geoffrey Hattersley-Smith, glaciologist with the Arctic section of the Canadian Defense Research Board, and Robert A. Blackadar, geologist of the Geological Survey of Canada, have departed for the Ellesmere Ice Shelf. The Shelf is a sheet of ice 10 to 15 miles wide and 100-200 feet thick fringing most of the northwest coast of Ellesmere Island. Its physical features will be compared with T-3 Fletcher's Island, a floating Arctic ice island near the North Pole, where the U.S. Air Force has its northernmost weather and geophysics research stations.

Five Capper Pass Awards have been given by the Councils of the Institution of Mining and Metallurgy and the Institute of Metals, London, for papers published in 1952 in the *Transactions of the Institution of Mining and Metallurgy* and the *Journal of the Institute of Metals*. The awards are made annually from a fund placed at the disposal of the Councils by the Directors of Capper Pass and Son, Ltd., of Bristol. Award winners were Edwin Davis and S. G. Temple, C. P. Paton, E. C. Ellwood and T. A. Henderson, P. M. J. Gray, and E. A. Hontoir.

The **Florida State Museum** has completed negotiations with the U.S. Department of the Interior through the National Park Service to excavate four Indian sites on the west bank of the Chattahoochee River. The National Park Service will make available a grant of $1500 for the work, which will be carried out in territory scheduled to be inundated by the construction of the Jim Woodruff Dam. Ripley P. Bullen, Curator of Social Sciences at the Museum, will direct the field work.

Five new members have been appointed to the staff of the **National Science Foundation.** Harry Alpert of the Bureau of the Budget will be study director for social science research; James W. Cole, Jr., of the University of Virginia will be program director for scientific manpower; Walter R. Kirner of the National Research Council will be program director for chemistry; Raymond W. Mayhew of the U.S. Navy will be physical science administrator; and H. Kirk Stephenson of the Los Alamos Scientific Laboratory will be program director for earth sciences.

The **Smithsonian Institution's Division of Physical Anthropology** has passed its 50th anniversary. Starting with a few boxes of bones in storage, this division has become one of the foremost depositories of human skeletal remains in the world, including more than 18,000 human skulls, representing essentially every division and subdivision of the human race. The Division was started in 1903 under the direction of the late Aleš Hrdlička, and the present curator is T. Dale Stewart. Marshall T. Newman is associated with Dr. Stewart.

A two-day symposium was held at the **University of Rhode Island** in connection with the dedication of the new Pastore Chemical Laboratory. Frederick G. Keyes of MIT, Charles A. Kraus of Brown University, and W. Albert Noyes, Jr., of the University of Rochester, discussed three phases of "Chemistry and the Progress of Man." Honorary degrees of Doctor of Science were conferred upon the three chemists at the University's convocation, and Farrington Daniels, Elvin C. Stakman, and Samuel T. Arnold were similarly honored. Dr. Stakman also addressed the University's new chapter of Sigma Xi.

ERRATUM. In the April 17th issue of SCIENCE on page 402, John Pfeiffer referred to J. G. Feinberg, author of *The Atom Story*, as a "British" biochemist. The book was commissioned by a British publisher, Allan Wingate, and was first published in England, but the author is an American.

Technical Papers

Meiosis in *Gymnosporangium* and the Cytological Effects of Certain Antibiotic Substances

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The cedar-hawthorne rust, *Gymnosporangium clavipes,* is a particularly suitable fungus for cytological study in that the teliospores when stored at a low temperature frequently remain viable for a long period of time, and the nuclei are relatively large, 8–10 μ in diameter. The experimental procedure was as follows: twigs of red cedar infected with the telial stage of *G. clavipes* were kept at a cool temperature in a dried condition and germinated over a period of 6 months. Each slide was prepared by placing a portion of a telial sorus in a drop of tap water on a slide, which is kept in a moist chamber. At appropriate intervals in basidial development, the gelatinous mass of germinating teliospores was smeared on the slide, and killed and fixed in a modified Carnoy's fluid containing chloroform, and then stained by the propionocarmine technique. The entire process of teliospore germination, basidial development, and basidospore formation takes place in 5–6 hr.

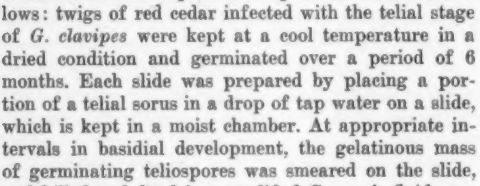

FIG. 1. Unusually elongated spindle of Anaphase I with lagging chromosomes, after treatment with 1000 ppm of streptomycin. × 1600.

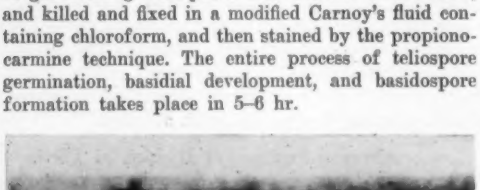

FIG. 2. Chromatic clumps representing unequal groups of chromosomes during the first meiotic division. Treated with 1000 ppm of streptomycin. × 1600.

Studies of normal cytology indicate that the diploid number of chromosomes as found in the unreduced nucleus in the basidium is 16 (8 bivalents), while the haploid number, found passing to each pole in the first and second divisions of meiosis, is 8. The chromosomes range in size from 1.0–4.7 μ at metaphase I of meiosis, and there is present a distinct nucleolus chromosome. Chromosome number determinations have also been made at metaphase I for *G. transformans, G. nidus-avis* and *G. juniperi-virginianae.* In all 3 of these species the haploid number of chromosomes is the same as in *G. clavipes,* namely 8. This appears to represent the first clear demonstration of chromosome numbers in the genus. The same number was found in *Cronartium* by Colley (*1*) and in *Coleosporium* by Olive (*2, 3*).

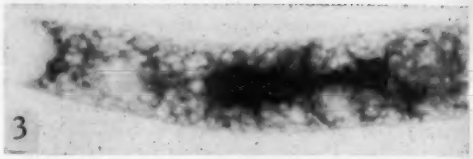

FIG. 3. Transverse septum in basidium cutting across a spindle, indicating a failure in synchronization between septum formation and nuclear division. Treated with 1000 ppm of streptomycin. × 1600.

The writers became interested in testing the effects of certain antibiotics on basidial development in *G. clavipes,* and the following 3 substances were used: penicillin G, streptomycin, and cycloheximide (Actidione), all kindly supplied by A. J. Whiffen of the Upjohn Co. In these experiments the telial sori were germinated in different concentrations of the antibiotic at various stages in basidial development and processed in the same manner as the control material previously described. The observable effects of these 3 antibiotics are often morphological as well as cytological. In certain cases fairly specific cytological effects can be produced. The following observations were made after periods of treatment varying from 1–5 hr.

The effective range of concentrations of penicillin G which showed consistent results was between 2000–5000 ppm. The most striking morphological effect of penicillin is to cause a forking of the basidium, or of the sterigma, depending on the time of application of the antibiotic. The nucleus has a tendency to remain in the teliospore or possibly to migrate back into it, again depending on the time of treatment. So far, in our work, the nuclei do not stain as well as in normal material and nuclear details are obscured.

Streptomycin has been the most rewarding and interesting of the 3 substances studied. The range of concentrations most effective was relatively high—between 1000–10,000 ppm. One of the interesting effects of streptomycin is to induce the basidia to form side arms superficially resembling clamp connections. Also there frequently occurs a back migration of one of the nuclei into the teliospore following the first meiotic division. Streptomycin also affects the synchronization between nuclear divisions and cross-wall formation in the basidium, which often results in the formation of a wall cutting across a nucleus or spindle (Fig. 3). This may be due to a retardation or cessation of the nuclear divisions induced by application of the antibiotic. This interference with nuclear division occa-

sionally results in the formation of several chromatic clumps, apparently representing unequal groups of chromosomes (Figs. 1 and 2). These groups may sometimes be found still connected to each other by chromatic strands.

Cycloheximide, like streptomycin, is an antibiotic produced by *Streptomyces griseus*, and has marked fungicidal properties. Whiffen (*4*) recently showed that the treatment of the sporophytes of *Allomyces arbuscula* with cycloheximide in very low concentrations resulted in the development of gametophytic outgrowths, thus indicating somatic reduction. However, this effect was observed only after 10–14 days, in contrast to the early observable effects upon the basidia of *Gymnosporangium*. According to Wilson (*5*), the substance has been shown to have interesting cytological effects in onion-root tips, in which it may induce the formation of "reductional groupings" of chromosomes during somatic mitosis. In our work with *Gymnosporangium*, the effective range of concentrations of cycloheximide has been found to be between 5–500 ppm. At the higher concentrations basidial development is almost completely inhibited and the nuclei become very large, with much extended chromosomes. Cycloheximide also causes a forking of basidia similar to that induced by penicillin, and in some instances there occurs a lagging of the chromosomes during meiosis. Lower concentrations cause a return of one of the nuclei to the teliospore, as was found in penicillin- and streptomycin-treated material. The most striking effect of cycloheximide is observed in the occurrence of many basidia with 2 nuclei closely associated, or still connected to each other by chromatic strands, in sharp contrast to the usual long distance between daughter nuclei following anaphase. This may be due to malfunction or disintegration of the spindle and might result occasionally in the reconstitution of a single diploid nucleus rather than two haploid ones.

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Manuscript received November 12, 1952.

Effects of Hyaluronidase on Human Gingival Epithelium[1]

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As part of a study of the mechanism by which accumulations of gingival bacteria produce marginal inflammation, we were able to demonstrate the presence of a "spreading factor" in cell-free extracts of gingival debris. This fact, together with the known presence of the enzyme hyaluronidase in saliva (*1*) and

[1] Supported by U. S. Army Grant No. DA-49-007-MD-159.

FIG. 1. Gingival tissue after 2 days of treatment with hyaluronidase. Paraffin embedding; section thickness 6 μ; stained with Masson's Trichrome stain. Area of dissolution of the pocket epithelium indicated. The connective tissue presents an irregular appearance.

the demonstration of high production of hyaluronidase by certain oral bacteria (*2*), made it seem important to examine the effect of this enzyme applied topically on human gingival tissues. The connective tissue reactions stimulated by hyaluronidase have been described previously (*3, 4*). However, these descriptions do not discuss the changes brought about in the epithelium or the manner by which the enzyme can reach the underlying connective tissue. Apart from general interest, this problem has special importance in gingivitis because it is not known whether the hyaluronidase reaches the connective tissue as the result of trauma, through a weak epithelial attachment, or by passage through the epithelium itself.

Biopsies of human gingiva exposed to the action of hyaluronidase (Wydase) were chosen as a means of determining the tissue reactions. Both experimental and control tissues were taken from each of 36 individuals' normal and inflamed gingiva. The hyaluronidase solution was always used in a fresh state as 150 TR.U./cc in sterile triple-distilled water. It was introduced into the gingival crevice by a small syringe; extreme care was taken to avoid injury to the tissue. The delivery rate was about 12 TR.U./min. When inactivated hyaluronidase was used, the enzyme was either inactivated by heat or by addition of heparin to the solution. After the experimental period, the treated gingival tissues were carefully removed by biopsy. After fixation in Carnoy's fluid the tissues obtained were embedded in paraffin and sectioned. A

variety of staining procedures was employed: Harris' hematoxylin and eosin; the Masson Trichrome stain for registration of epithelial changes; the Gomori silver strain and the Weigert fuchselin-GG combination for demonstration of elements of the connective tissue; and the Gram-positive microorganisms in tissues. Two histochemical techniques were carried out routinely: the Hotchkiss procedure for demonstration of polysaccharide-containing materials in tissues, and the Hale staining techniques for demonstration of hyaluronic acid in tissues.

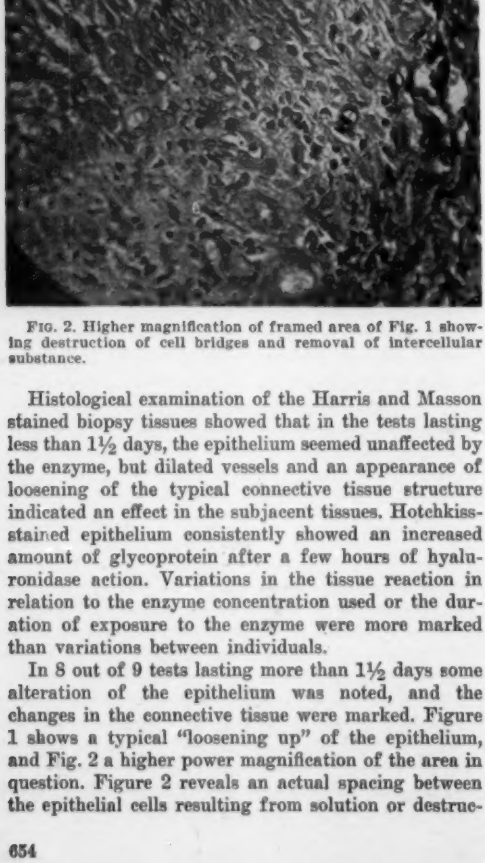

FIG. 2. Higher magnification of framed area of Fig. 1 showing destruction of cell bridges and removal of intercellular substance.

Histological examination of the Harris and Masson stained biopsy tissues showed that in the tests lasting less than 1½ days, the epithelium seemed unaffected by the enzyme, but dilated vessels and an appearance of loosening of the typical connective tissue structure indicated an effect in the subjacent tissues. Hotchkiss-stained epithelium consistently showed an increased amount of glycoprotein after a few hours of hyaluronidase action. Variations in the tissue reaction in relation to the enzyme concentration used or the duration of exposure to the enzyme were more marked than variations between individuals.

In 8 out of 9 tests lasting more than 1½ days some alteration of the epithelium was noted, and the changes in the connective tissue were marked. Figure 1 shows a typical "loosening up" of the epithelium, and Fig. 2 a higher power magnification of the area in question. Figure 2 reveals an actual spacing between the epithelial cells resulting from solution or destruction of cell-bridges and intercellular substance. The connective tissue presents an irregular appearance with large vacuoles and dilated vessels. Another irregularity that indicates changes in the epithelium was revealed by the Masson stain, which produced purple-to-bluish colored areas in the epithelial tissue instead of the usual bright red coloration. In marked contrast to the control sections (Fig. 3), the Hotchkiss stain demonstrated a rather large increase of stainable polysaccharide material within the epithelial layers of the experimental area (Fig. 4).

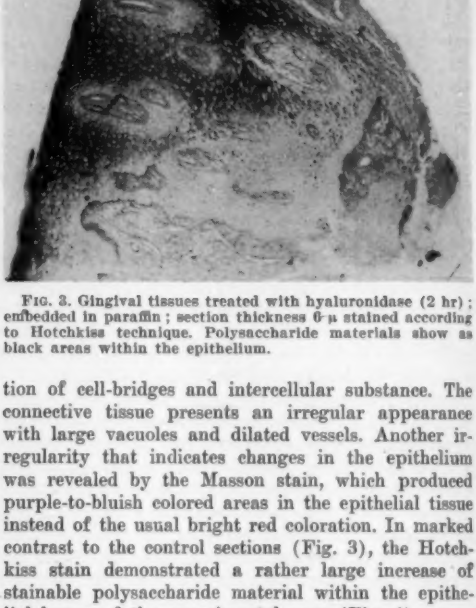

FIG. 3. Gingival tissues treated with hyaluronidase (2 hr); embedded in paraffin; section thickness 6 μ stained according to Hotchkiss technique. Polysaccharide materials show as black areas within the epithelium.

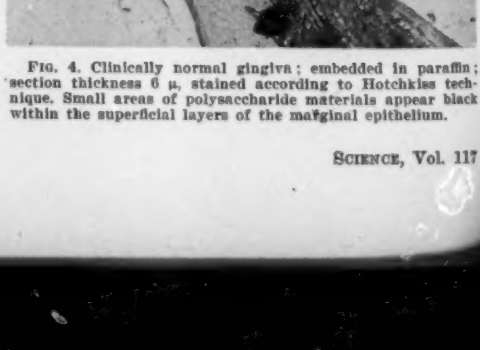

FIG. 4. Clinically normal gingiva; embedded in paraffin; section thickness 6 μ, stained according to Hotchkiss technique. Small areas of polysaccharide materials appear black within the superficial layers of the marginal epithelium.

It may be concluded that the initial effects of hyaluronidase on epithelium are an increase in polysaccharide-containing materials and prolonged action which is capable of altering the intercellular substance in the gingival epithelium, thereby permitting passage of destructive agents to the underlying connective tissues. In the connective tissue, hyaluronidase produces dilated vessels, vacuolation, and breakdown of the typical structure.

On the basis of these findings, it is suggested that various hyaluronidase-like products of gingival bacteria may produce similar changes in the gingiva and thus contribute to gingivitis.

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Manuscript received October 30, 1952.

Reversible Reaction of Chlorophyll Giving the Red-Brown Intermediate of the Molisch Phase Test[1]

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Chlorophyll[2] *b* or *b'* which had its solvent removed at 0° C in a vacuum line was covered with isopropyl amine by condensation at the temperature of dry ice, and at once a red color appeared as the chlorophyll dissolved. The temperature was then raised gradually, and the color changed, acquiring a greenish tint, becoming red-brown, green-brown, and finally green. At about 230° K, the spectrum approached the standard spectrum of chlorophyll (*1*) *b* or *b'*. When the temperature was then lowered, the change in color followed in reverse order. However, if the solution had been kept any length of time at the higher temperature, the original intensity of the red was not fully restored. An irreversible reaction had transformed the chlorophyll into another substance as the spectrum confirmed at the higher temperature.

Figure 1 shows the spectra of chlorophyll *b'* as they change with temperature. The chlorophyll was dissolved in 10% mono-isopropyl amine in 1:1 propane-propene. Figure 2 gives the spectra of chlorophyll *a* dissolved in 10% isopropyl amine, 10% isopropyl benzene, and the remainder 1:1 propane-propene. When the amine was diluted, as in the above solutions, the extent of the irreversible reaction was unimportant even at the highest temperature we are considering.

Our identification of the colored intermediate substances with those of the Molisch phase test rests on the spectra obtained by Duniez *et al.* (*2*) at the confluence of two streams at room temperature, one consisting of chlorophyll in ether and the other trimethyl benzyl ammonium hydroxide in methanol. This technique had been devised to cope with the fact that the brown color disappeared in a fraction of a second at room temperature. The finely dotted curve in Fig. 2

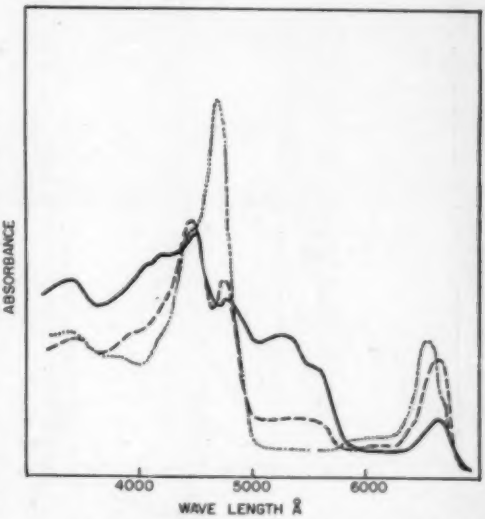

Fig. 1. Chlorophyll *b'* in 10% mono-isopropyl amine and 1:1 propane-propene, ... 230° K, – – – – 193° K, —— 160° K.

gives the absorption spectrum of the brown intermediate of chlorophyll *a* when correction has been applied for the presence of chlorophyll as well as of the end product of the irreversible reaction. The similarity in the structure of this absorption with that obtained at the lowest temperature in Fig. 2 is evident, especially so in the strong absorption in the green region 4500 to 5500 A. Also should be noted the simultaneous decrease with decreasing temperature in the intensities of the characteristic absorption peaks of chlorophyll in the red and in the blue.

When the isopropyl amine was diluted with hydrocarbons, a lower temperature was required to match the intensity of the color that was obtained when the solvent consisted of pure amine. Since the formation of the intermediate depended on the concentration of the base, the reaction was at least bimolecular. As confirmation may be offered the discovery that the green solution was frozen-in by sudden quenching to the temperature of liquid nitrogen even though the solution still remained fluid. On allowing the temperature to rise gradually, very little change in color was ob-

[1] Research carried out under the auspices of the U. S. Atomic Energy Commission.

[2] Solutions of purified chlorophylls *a*, *b*, and *b'* and of allomerized chlorophyll *a* in ether were generously furnished us by Robert Livingston and his associates at the University of Minnesota. ONR Project N60 ri-212 Task Order 1.

served until the temperature had reached about 150° K. Then transformation occurred quickly as the colors changed to olive green, at about 160° K to red-brown and at higher temperatures to green, so that above about 150° K, the concentrations of the coexisting species may well have been virtually those at equilibrium. We are unable to decide definitely whether chemical activation energy or the diffusion process limits the rate of the reaction. The hint given by the

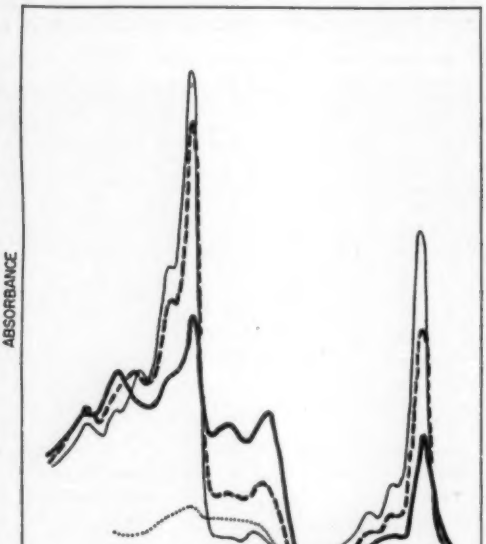

FIG. 2. Chlorophyll *a* in 10% mono-isopropyl amine, 10% isopropyl benzene, and 80% 1 : 1 propane-propene; —— 190° K, – – – – 170° K. —— 160° K. Curve marked ..... has been derived by Dunicz *et al.* for the intermediate of chlorophyll *a* at 300° K.

concentration dependence of the base would suggest the latter. There seems to be good evidence (*2, 3*) that the brown intermediate results from an acid-base neutralization which would ordinarily require little chemical activation energy. According to this view, the chlorophyll molecule is conceived as an acid with its hydrogen ion furnished by the labile hydrogen on carbon-10 of the pentanone ring. Activation may then be principally a measure of the lability of the hydrogen. The ion is removed by the base upon neutralization, leaving a negative charge which profoundly affects the resonating circuits of the chlorophyll molecule. In confirmation the fact has been adduced that allomerized chlorophyll does not undergo the Molisch phase test. (In this substance, a methoxy group has supposedly replaced the acidic hydrogen on carbon-10 of the chlorophyll molecule.) We have found, in fact, that a solution of allomerized chlorophyll *a* in isopropyl amine does not become brown even at the lowest temperature.

In addition to the transformations we have been discussing, others are taking place which are especially clear at temperatures at which the equilibrium concentrations of the intermediate are small. These seem to have the same characteristics as were found (*4*) to occur in rapid equilibria between species of chlorophylls in common solvents such as ether.

However, the basicity of the solvent does not appear to be the sole requirement for the formation of the brown intermediate, because with chlorophyll *b* in di-isopropyl amine no such color was observed unless one accepts as indication of its presence a shoulder on the long wavelength slope of the band in the blue region of the spectrum. The color remained substantially unchanged from room temperature to that of liquid nitrogen when hydrocarbon had been added to make the solution fluid at that temperature.

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Manuscript received November 4, 1952.

The Staining of Synaptic Terminals Within the Central Nervous System by Rio-Hortega's Double Impregnation Silver Method[1]

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Since the demonstration by Pamón y Cajal in 1888 (*1*) of the minute structure of neuronal interconnections in the retina and cerebellum, several workers have described similar synaptic *boutons terminaux* in other parts of the nervous system (*2–4*). Many such observations have been incidental in nature. Today, however, there is an increasing demand for specific information about the structure of the synapse, and a concern for definitive techniques for its staining. Moreover, it is becoming evident that, for lack of a good method of demonstrating synaptic terminals, neurohistology is lagging behind its more productive counterpart, neurophysiology. In this study Rio-Hortega's double impregnation method (*5*) for the staining of neurofibrils has been applied to the problem and, with minor modifications, has been found to provide a fairly consistent and simple method for staining the *boutons terminaux* in formalin-fixed material from the human cerebral cortex, cerebellum, and spinal cord. It has been possible thus to establish the

[1] This work was carried out with the assistance of a Federal Mental Health Grant.

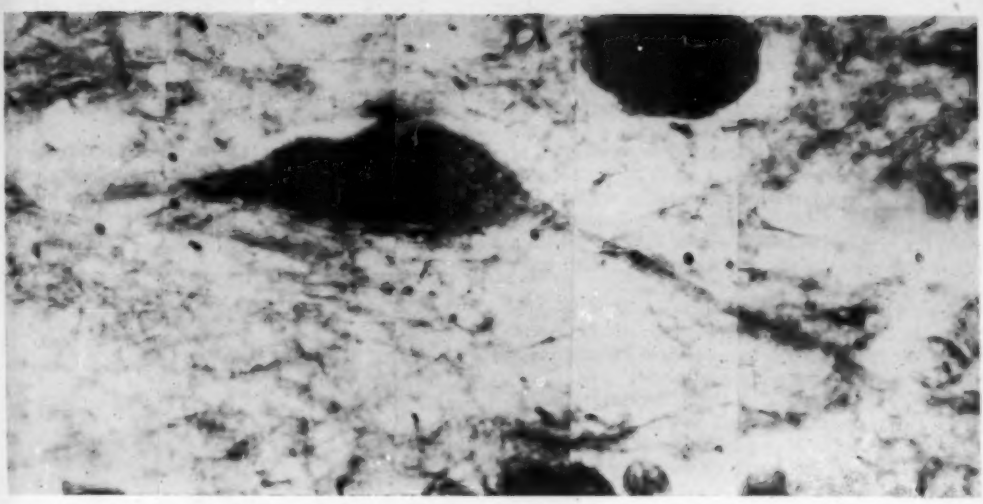

FIG. 1a. Large neurone in the human precentral cortex with a total of 11 ringlike *boutons terminaux* ending upon the cell body or its dendritic processes. × 1200.

ringlike axonal endings as the common denominator of transmission mechanisms throughout the human nervous system.

The annotated method follows: Nervous tissue which has been well fixed in 10% neutral formaldehyde is cut into blocks (5 mm thick by 2 cm square) and sectioned on a freezing microtome at 15 μ. The sections are received into a Petri dish filled with distilled water bearing 10 drops of concentrated ammonia.

By blowing vigorously on the sections it is possible to "wash" them adequately and without damage in this and in two succeeding baths of distilled water. With a small glass "hockey stick" the sections are transferred to a 12-cc Pyrex cup filled with 2% silver nitrate (C.P.) to which 4 drops of chemically pure pyridine have been added. (Solutions of silver nitrate up to 5% in distilled water may be used, though there is an added risk of fine precipitate being deposited on the sections by the addition of pyridine.)

After gentle heating at 45° C for 10–30 min the sections take on a tobacco color, whereupon they must be washed in a Petri dish of distilled water with further blowing. Sections are then transferred to another chemically clean Pyrex cup holding 4 drops of pyridine and 12 cc of so-called "silver carbonate." This solution is prepared by adding 67 cc of 10% silver nitrate to 267 cc of 5% sodium carbonate (C.P.) and adding distilled water to 1000 cc. The resultant precipitate is dissolved by the adding of concentrated am-

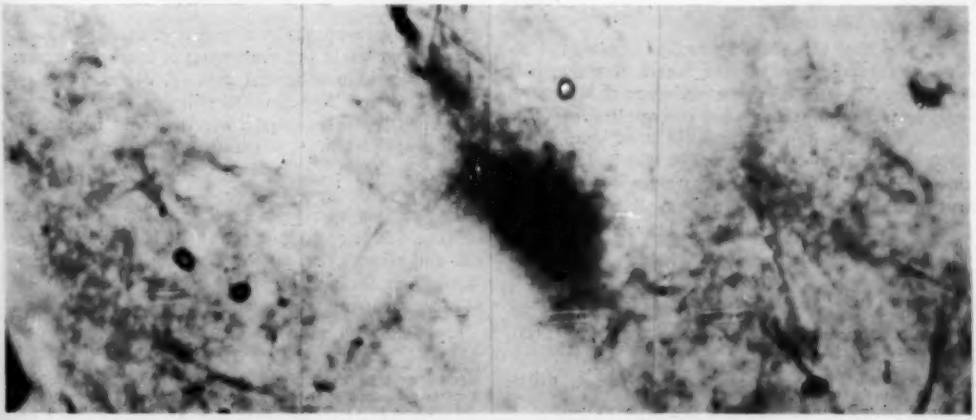

FIG. 1b. Degenerating *boutons terminaux* of the cingulate gyrus in a patient who died 29 hr after frontal lobotomy. × 2800.

monia, drop by drop, until no more turbidity exists. The solution must be filtered and stored in brown glass bottles. After heating for another 10-min period at 45° C, or until deep brown in color, the increasingly brittle sections are carefully lifted into a Petri dish of distilled water, for a rapid wash.

Reduction is carried out in a 10% solution of formol. If desired, toning in a gold chloride solution (1:500) can be done, with a succeeding wash in distilled water and fixation in "hypo." Dehydration beyond the 97% alcohol stage can be completed with a carbol-creosote-xylol mixture with good results, prior to mounting in balsam.

Chemically clean glassware is essential if precipitate is to be prevented. Reagent chemicals are essential if the delicate nerve terminals are to be impregnated free from overlaying precipitate.

A slow impregnation in the refrigerator in 2% silver nitrate, lasting up to 1 month, has produced some very delicate impregnations with visualization of several synaptic terminals on one nerve cell of the human cerebral cortex.

The mechanism by which the neurofibrillar structures and their terminals take up silver nitrate is not well understood. The reinforcing of this stain by silver carbonate has great value in achieving specific neuronal, as against neuroglial, staining. Gold toning is well suited to this method because it relieves the background of much indistinct material.

It is not contended that all the synaptic endings on a nerve cell body and processes are made visible by this metallic method, but we believe that even in the cerebral cortex, where the staining of *boutons terminaux* is difficult, a fair proportion can be shown in favorable preparations (Fig. 1a). The postulation of some other method of synapsis in the human brain (*6*) on negative grounds is not supported by our studies on normal tissues. When there has been recent degeneration of nerve pathways in the cerebrum, the increased argyrophilia of the fibers brings into view very large numbers of swollen synapses around individual nerve cells.

The fact that this staining method gives good results on formalin-fixed tissues makes it universally applicable. The use of this staining method for recently lobotomized brains is but one application (Fig. 1b). In addition it offers promise of a simple and fairly consistent method for use in the elucidation of other problems in interneuronal transmission. Refinement of the technique itself, and possibly of methods of tissue fixation, is still needed to bring out its greatest potentialities.

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Manuscript received October 13, 1952.

The Oxidation of Chicken Fat Tissue[1]

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Ellman and McLaren (*1*) reported that a fatty acid oxidase was present in frozen poultry fat. Moore and Nelson (*2*), working with guinea pig mammary gland tissue, stated that this oxidative system (*1*) was probably autoxidation.

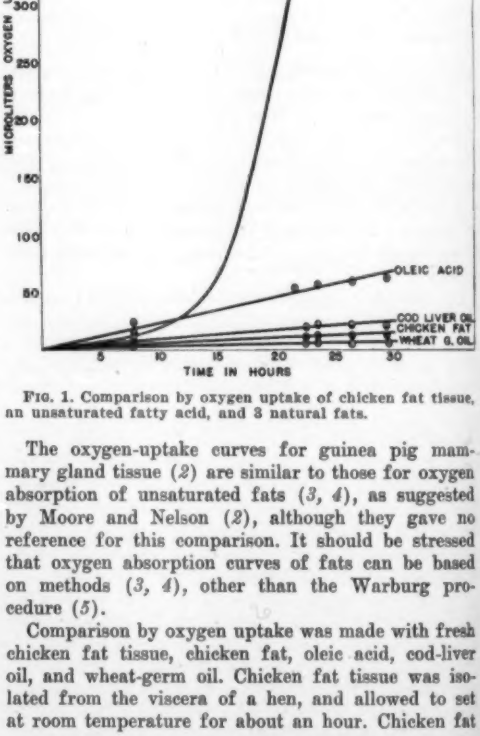

FIG. 1. Comparison by oxygen uptake of chicken fat tissue, an unsaturated fatty acid, and 3 natural fats.

The oxygen-uptake curves for guinea pig mammary gland tissue (*2*) are similar to those for oxygen absorption of unsaturated fats (*3, 4*), as suggested by Moore and Nelson (*2*), although they gave no reference for this comparison. It should be stressed that oxygen absorption curves of fats can be based on methods (*3, 4*), other than the Warburg procedure (*5*).

Comparison by oxygen uptake was made with fresh chicken fat tissue, chicken fat, oleic acid, cod-liver oil, and wheat-germ oil. Chicken fat tissue was isolated from the viscera of a hen, and allowed to set at room temperature for about an hour. Chicken fat

[1] Published with the approval of the Director as Paper No. 586, Journal Series, Nebraska Agricultural Experiment Station.

[2] Part of this research was supported by a Knights of Ak-Sar-Ben Research Fellowship. The senior author was a graduate student in the Department of Physiology, University of Nebraska. Present address, Creighton University School of Medicine, Department of Physiology, Omaha, Nebraska.

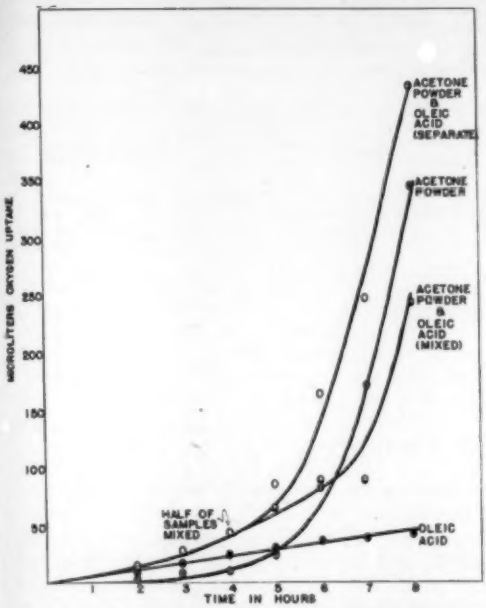

FIG. 2. Qualitative comparison by oxygen uptake of an acetone powder of chicken fat tissue and oleic acid.

as used for these experiments was the fat that melted free of the fat tissue at room temperature. Ten grams of each of the designated 5 substances was homogenized for 1 min with 30 ml of phosphate buffer of pH 7.6 in a Waring Blendor. All samples, except the chicken fat tissue, were boiled under nitrogen for 5 min in order to destroy any enzyme system that may have been present. Samples were then run on the Warburg respirometer, using the direct method, in an atmosphere of air at 37° C.

As can be seen from Fig. 1, the oxygen uptake for the fat tissue was greatly accelerated after 8 hr. Oleic acid, cod-liver oil, wheat-germ oil, and chicken fat all exhibited a progressive linear oxygen uptake. These results could not be accounted for by contamination with microorganisms.

The conclusion drawn from this was that the rapid oxygen uptake of the fat tissue system was dependent on the presence of tissue rather than fat. In order to further verify this conclusion, 45 g of finely chopped fresh chicken fat tissue was homogenized with cold acetone. The precipitate was washed 4 times in cold acetone, dried for 1 hr at 37° C, and resuspended in 270 ml of phosphate buffer of pH 7.6. A qualitative comparison of this suspension with a 2% homogenate of oleic acid was then made.

The acetone powder from the fat tissue took up oxygen very rapidly after an induction period of about 5 hr as is shown in Fig. 2. The primary difference between the oxygen-uptake curve of the chicken fat tissue (Fig. 1) and that of the acetone powder (Fig. 2) is that the fat tissue required a longer induction period before rapid oxidation started. This is possibly due to the presence of fat in the suspension. Additional evidence is that a homogenate of oleic acid lengthened the induction period of a suspension of the acetone powder. This is shown in Fig. 2. Boiling the acetone powder results in loss of activity.

The precise nature of this oxidative system is unknown. The authors do not believe that it can be explained as the autoxidation of a simple fat or fatty acid.

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Manuscript received November 13, 1952.

Enhancement of Lead Excretion in Humans by Disodium Calcium Ethylenediamine Tetraacetate[1, 2]

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Ethylenediamine tetraacetic acid or Versene (EDTA), is a synthetic chelating agent used industrially on a large scale for the control of cations in solution. The compound forms strong, un-ionized, soluble chelate complexes with cations, especially those of the di- and trivalent type. In this way many characteristic effects of metal ions in solution may be controlled. When administered to animals and humans intravenously, the primary acute action of the compound in large doses over short periods was to lower the systemic calcium levels (*1, 2*). At extreme dosage hypocalcemic tetany was observed in animals. In contrast to this effect of EDTA, the administration of the preformed calcium chelate was without effect on calcium homeostasis (*3*). The preformed calcium EDTA was also singularly nontoxic by all routes (*4, 5*). The absence of toxicity of the compound may be attributed to its physiological inertness, since 99% of the material tagged in the methylene position with radioactive carbon could be recovered from the urine after intra-

[1] Trade name "Disodium Calcium Versenate"—Bersworth Chemical Co., Framingham, Mass.

[2] Supported in part by Grants-in-Aid from Washington Academy of Sciences and Bersworth Chemical Co., Framingham, Mass.

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[6] Columbia Hospital, Milwaukee, Wis.

[7] We wish to thank F. C. Bersworth for many helpful and fruitful suggestions in the course of this work.

TABLE 1

EFFECT OF CALCIUM *EDTA* ON URINARY LEAD EXCRETION IN HUMANS

Day	Patient A			Patient B			Patient C*			Patient D		
	Treatment	mg Pb/l	Total mg Pb excreted	Treatment	mg Pb/l	Total mg Pb excreted	Treatment	mg Pb/l	Total mg Pb excreted	Treatment	mg Pb/l	Total mg Pb excreted
1	None	3.13	1.06	None	< 0.20	—	None	0.42	0.12	0.5 g	0.58	1.01
2	None	2.93	1.14	None	< 0.20	—	None	< 0.20	—	0.5 g	7.12	6.98
3	None	—	—	None	< 0.20	—	0.5 g	2.63	1.53	0.5 g	3.93	6.07
4	None	—	—	None	< 0.20	—	0.5 g	2.02	1.47	0.5 g	1.96	3.45
5	None	1.34	0.47	None	< 0.20	—				0.5 g	2.17	2.93
6	None	2.74	0.49	0.5 g	2.40	1.33				None	< 0.20	—
7	0.5 g	4.62	0.93	0.5 g	2.76	1.81				None	0.27	0.43
8	0.5 g	7.19	3.06	0.5 g	1.50	*				0.5 g	1.63	3.50
9	0.5 g	7.19	3.06	None	1.90	1.64				0.5 g	2.17	1.35
10	None	0.27	0.05	None	< 0.20	—				0.5 g	0.46	0.86
11	None	3.10	1.13	1.0	1.22	1.35				0.5 g	1.04	0.84
12	None	1.50	0.23	1.0 g	3.20	1.36				None	< 0.20	—
13	None	0.83	0.05							None	0.59	0.49
14	1.0 g	1.99	1.22							0.5 g	< 0.20	—
15	1.0 g	6.64	3.45							0.5 g	0.27	0.42

* Incomplete collection.

venous administration (*6*) to rats. The favorable pharmacological properties of the preformed calcium EDTA chelate, combined with the fact that calcium in this complex may be displaced by other metals, including lead (*7*), led us to examine its possibilities in metal poisoning. The detoxicant and antidote action of calcium EDTA in experimental nickel, copper, cadmium, lead, and cobalt poisoning was reported (*8*). Marked enhancement was demonstrated of the excretion of lead from rabbits given intravenous lead acetate (*8*) followed by intravenous calcium EDTA. Since this report, we have been able to study the effect of this compound on eleven cases of acute and chronic lead poisoning in humans. The preliminary clinical findings have been presented (*9, 10*) and a more extensive description of the medical observations is in preparation. The present report deals with the effect of the compound on lead excretion in humans.

Urine collections in the cases of young and comatose patients was made by indwelling catheter. The samples were collected in acid-washed Pyrex bottles. Occasional samples in these 24-hr collections were lost by accidental spillage. While the concentration of lead in these partial samples has been recorded, the total excretion has been omitted from the tabulation. Lead analysis was carried out on 25-ml aliquots of the total urine samples. The method of analysis was as follows: To the 25-ml aliquot of urine was added 1 ml of "low lead" sulfuric acid and 5 ml of conc. nitric acid. The sample was evaporated to about 3 ml on a hot plate. The nitric acid addition and evaporation was repeated until all readily oxidized material was gone. This usually required a total of three to four nitric acid evaporation repetitions. A final ashing was conducted after the addition of 1 ml of perchloric acid and 3 ml of nitric acid. The cooled residue of ashed sample was then analyzed for lead by the standard dithizone colorimetric procedure (*11*). With every unknown sample, simultaneous analysis of a reagent blank, recovery of a standard sample of lead, and recovery of an added known amount of lead in urine was conducted. The analytical method gave recoveries of 98–102% in the range of 0.2 to 12 mg/l of lead.

In Table 1 are recorded the urinary lead excretions of four patients treated with intravenous calcium EDTA. Patients A, B, and C* were children of ages 3–5. Patient D was a male adult. Patients A and D were started on the drug while in an acute phase of lead poisoning as was indicated by the clinical symptoms. Patient B had survived an acute episode of lead poisoning and was treated two weeks subsequent to this event. Patient C, suffering from chronic lead poisoning, was treated a week following exacerbation of the symptoms due to respiratory ailment. The data reported indicate that administration of calcium EDTA resulted in marked enhancement of the lead excretion in these patients.

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Manuscript received November 10, 1952.

* This patient was treated by G. Ahrens, Babies Hospital, New York. We wish to thank Dr. Ahrens for the urine samples.

The Effects of Fertilization and Growth-regulating Substances (Hormones) on Carbohydrate and Hexose-phosphate Metabolism During the Early Stages of Growth of Corn Kernels (Fruit)[1]

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It has been shown by Murneek (*1*) and Marrè and Murneek (*2*) that the hormones produced in the seed after fertilization have an important role in regulating the movement of carbohydrates and nitrogen toward the developing fruit. Similarly, externally applied growth regulators (hormones) stimulate the accumulation of sugars and the formation of starch reserves in the young tissues of the flower and of the fruit (*2, 3*).

The purpose of these investigations was to establish a relationship between fertilization and hormone treatment with regard to their effects on carbohydrates and phosphate esters in young kernels (fruits) of corn, a plant in which parthenocarpy can be induced by the treatment with growth-regulating substances (*4*).

Ears of an inbred line of sweet corn, grown at 25° C in a well-lighted, thermoregulated greenhouse, were treated, after partial removal of the husks, as follows: (*a*) the silks were stripped and the kernels sprayed with an emulsion of water and lanolin without hormone—not pollinated controls; (*b*) the silks were pollinated with fresh pollen; (*c*) the silks were stripped and the ears sprayed with a hormone-lanolin emulsion.

The hormones used were the ethyl ester of indoleacetic acid (EtIA) and naphthaleneacetic acid (NA). Both substances were used at a concentration of 1000 ppm, which appeared effective in promoting the parthenocarpic development of the kernels. The ears were protected by a small bag from undesired pollen and from excessive evaporation. Treatments were performed on ears bearing silks ripe for pollination on different days in order to permit a simultaneous collection of material 0, 1, 3, 5, and 7 days after the treatment.

The chemical determinations were made on plant material from at least 6 ears; kernels from the lower third of the ear were used. Starch, sucrose, and reducing sugars were assayed as in a previous work (*2*). The hexose phosphates were determined according to procedure B of Umbreit *et al.* (*5*). Three precipitations with barium and alcohol removed practically all reducing substances other than the hexose phosphates. Significant losses in this procedure were observed only for glucose-1-phosphate, data on which therefore are not reported. The other esters, after purification and fractionation, were determined from their reducing values by the Somogyi reagent as used by Cori (*6*), and with the Roe method (*6*).

A. *Carbohydrates in the kernels.* No significant changes occurred in the carbohydrate content in the not pollinated, lanolin-treated kernels (Fig. 1). On the contrary, in both the hormone treated and the pollinated-fertilized ones marked changes were induced in sucrose, starch, and reducing sugar concentrations. This reaction was qualitatively similar in cases of pollination, EtIA, and NA treatments and consisted of: (*a*) a distinct increase in starch content from a very low initial amount; (*b*) in a decrease,

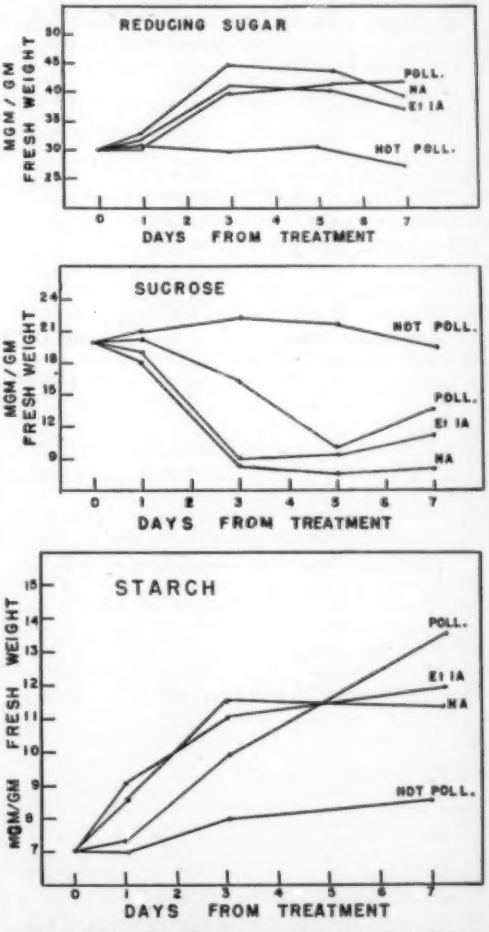

FIG. 1. Effect of fertilization and of hormone treatment on the carbohydrate content of corn kernels. Poll., pollinated; EtIA, treated with ethyl ester of indoleacetic acid; NA, treated with naphthaleneacetic acid; Not Poll., not pollinated, treated with lanolin.

[1] Journal Series Paper No. 1329 approved by the director of the Missouri Agricultural Experiment Station.

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chiefly during the first 3 days after treatment, of sucrose; and (*c*) in an increase of reducing sugar concentration.

This reaction is very similar to the one previously observed in tomato ovaries (*2*). It appears closely linked to changes in the enzymatic equilibria concomitant with an increase in growth of the fruit.

B. *Carbohydrates in the cob.* The carbohydrate changes in the cob (Fig. 2) followed the same trend as those in the kernels. Here again an increase of starch and reducing sugars and a decrease of sucrose were observed. This similarity of behavior indicates that the action of the hormones (natural or artificially applied) on the carbohydrate metabolism is not confined to the seed- and fruit-forming organs but may have analogous effects on neighboring tissues.

C. *Hexose phosphates in the kernels.* The changes in the hexose phosphates in kernels after the different

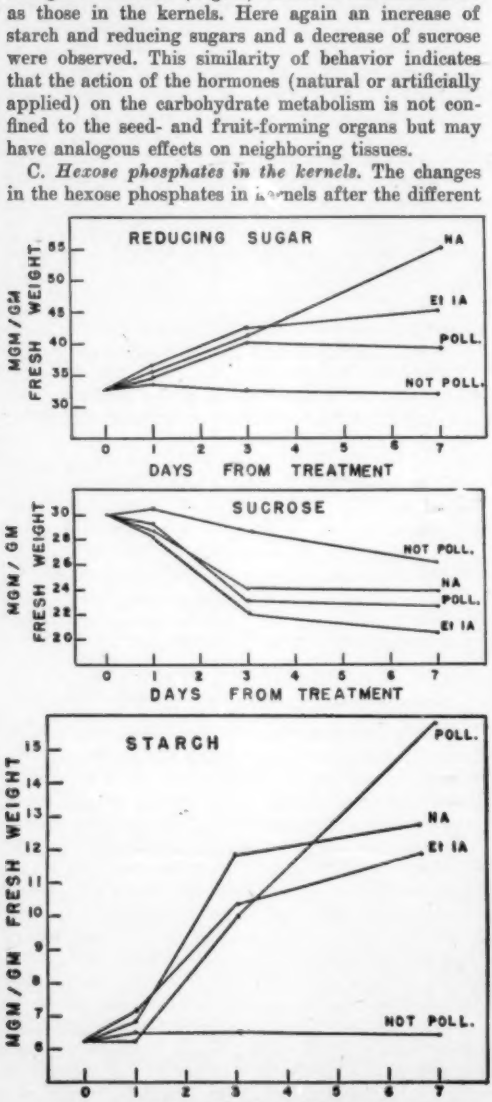

FIG. 2. Effect of fertilization and of hormone treatment on the carbohydrate content in corn cobs.

TABLE 1

CONCENTRATION OF THE HEXOSE PHOSPHATES IN FERTILIZED, HORMONE-TREATED, AND NOT POLLINATED CORN KERNELS, 3 AND 7 DAYS AFTER TREATMENT

(In γ/g fresh weight)

	3 days after treatment	
	Fructose-6-P and Glucose-6-P (determined together)	Fructose-1-6-P
Pollinated	475	48
EtIA	503	51
NA	515	54
Not pollinated	425	41

	7 days after treatment		
	Fructose-6-P	Glucose-6-P	Fructose-1-6-P
Pollinated	158	375	48
EtIA	187	405	52
NA	193	395	54
Not pollinated	117	305	35

treatments seem worthy of some attention, though the behavior of these compounds in relation to growth is, as yet, very little known. The data in Table 1 show that fertilization, as well as the treatment with growth regulators, induced a moderate but significant increase of all considered hexose phosphates. The interest in these data lies in the fact that they may indicate a relationship between growth and the rate of phosphorylation of the carbohydrates. It seems reasonable to assume that in the actively growing ovary, the growth resulting from either hormone treatment or fertilization, the hexose phosphates should be utilized at a higher rate than in a resting one. Notwithstanding this most probable situation, the hexose phosphate concentration actually increased in the growing ovary, thus showing that the production of these compounds was, under these circumstances, larger than their utilization. This fact suggests a significant increase in the rate of phosphorylation of the hexoses. Such a condition could result from two different mechanisms: (*a*) from a hormone-induced activation of respiratory enzymes (*7*) with a consequent increase in the production of high-energy P-bonds; (*b*) from the activation of the P-transferring mechanisms, as of the enzymes of the hexokinase type. It should be considered that in the second consideration (*b*) the rate of respiration should increase, as a result of the faster turnover of ATP (or similar compounds) and therefore of the greater availability of acceptors of high-energy phosphorus from the respiratory reactions (*8*). It is known that both fertilization and auxin treatment are usually followed by an increase in respiration (*9*).

In an attempt to correlate the behavior of the hexose phosphate with that of the soluble carbohy-

drates, a relation seems probable between the stimulation in synthesis of starch and the higher level of the phosphorylated sugars in the growing kernels. There is every reason to believe that in corn kernels, as in other plant structures, the enzyme primarily concerned with starch synthesis is phosphorylase, acting on glucose-1-phosphate. As there is some evidence of the common occurrence in plants of the enzymes necessary for the interconversion of the different hexose phosphates, a greater activity of phosphorylase should naturally be considered favorable for starch synthesis.

The close analogy between the effects on carbohydrate metabolism of the hormones naturally released after fertilization and those of the growth regulators artificially applied should be emphasized. This analogy suggests a corresponding similarity in regard to metabolism. The fact that the response following pollination is always somewhat delayed, compared to the response following hormone treatment, seems to indicate that fertilization, which in the corn follows pollination in about 24 hr, rather than pollination, is the process responsible for the maximum production of metabolically active hormones (*10*).

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Manuscript received October 24, 1952.

Rate of Turnover of Epinephrine in the Adrenal Medulla

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Experiments designed to determine the precursors and intermediates involved in the biosynthesis of epinephrine have yielded the observation that the rate of formation and the normal rate of secretion of adrenal epinephrine are extremely slow. C^{14}-labeled phenylalanine or tryosine administered orally or intraperitoneally to rats or rabbits was incorporated into adrenal epinephrine much more slowly than into the tyrosine of plasma protein (Table 1). The resulting radioactive adrenal epinephrine disappeared slowly after the administration of the labeled amino acid was discontinued; the half-life in rats was about 9 days. Estimates of half-life were based upon measurements of the specific activity of adrenal epinephrine[3] in individual rats which were sacrificed under Evipal anesthesia at various time intervals after discontinuing administration of C^{14}-phenylalanine (Fig. 1). In three additional experiments adrenal glands were compared in the same rats, the glands being removed one at a time several days apart (Table 2).

TABLE 1

Incorporation of C^{14} from Phenylalanine and Tyrosine into Plasma Protein Tyrosine and Adrenal Epinephrine of Rats

Expt.	C^{14}-amino acid administered[a]	Days	Time after last dose	Specific activity (cpm/μmole) Free plasma tyrosine	Plasma protein tyrosine	Adrenal epinephrine
1	Phenylalanine	1	7 hr	80	34	< 5
2	Tyrosine	1	7 "	110	46	< 5
3	Tyrosine	6	24 "	700	—	280
4	Phenylalanine	6	24 "	930	340	180
5	Tyrosine	6	24 "	600	450	310
6	Phenylalanine	12	20 "	—	—	980
7	Phenylalanine	12	12 days	150	610	420

[a] 3-C^{14}-D-L-phenylalanine (2.6×10^6 cpm/μmole) or 2-C^{14}-D-L-tyrosine (2.0×10^6 cpm/μmole) were administered in doses of 1 mg/day for the number of days indicated.

In an attempt to stimulate the synthesis of epinephrine, the adrenal glands of rabbits were depleted of epinephrine by the subcutaneous administration of insulin.[4] Epinephrine was determined in the adrenals of individual rabbits sacrificed at various time intervals following insulin administration. The chemical method used was a modification of the fluorimetric procedure of Lund (*1*), which can measure epinephrine in the presence of nor-epinephrine and other catecholamines. It was found that about half of the epinephrine which had disappeared from the adrenal glands after insulin administration was restored in 72 hr (Table 3). No measurable quantities of nor-

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[3] A portion of an adrenal extract was assayed for epinephrine by the procedure of Lund (*1*). To the rest of the extract a measured quantity of nonisotopic l-epinephrine (about 10 mg) was added as a carrier. The carrier was recrystallized repeatedly until isotopic homogeneity was achieved. In a number of cases the recrystallized carrier was converted to a derivative, iodoadrenochrome (*2*), with no change in isotopic composition. The quantity of epinephrine in the adrenal extract (m), the quantity of added carrier (M), and the specific activity of the isolated carrier (C_s) permit calculation of the specific activity of the adrenal epinephrine (C_a) according to the equation $C_a = C_s M/m$, derived from isotope dilution principles.

[4] After insulin administration the blood sugar levels fell to negligible values in 2–3 hr and returned to normal by 8 hr.

epinephrine were found in the glands at any time. In rats also the synthesis of adrenal epinephrine was found to be slow after its depletion by the administration of insulin.

These findings in rats and rabbits are in general agreement with the slow rate of synthesis found by the isotopic experiments. However, they are contrary to the observations of West (*3*) who, using physiological assay procedures, found that adrenal epinephrine in rabbits fell rapidly after insulin administration and returned to normal values within 8–10 hr. It is possible that the discrepancy between our findings and those of West lies in some other substance in adrenals which assays as epinephrine by physiological assay. This substance cannot be nor-epinephrine, because the rabbit adrenal gland contains only traces of this compound.

TABLE 2

COMPARISON OF SPECIFIC ACTIVITIES OF ADRENAL EPINEPHRINE IN INDIVIDUAL GLANDS REMOVED SEVERAL DAYS APART

Expt.	Adrenal	Time elapsed after discontinuing C^{14}-phenylalanine* (days)	Specific activity of adrenal epinephrine (cpm/μmole)	Estimated half life (days)
16	Left	3	600	9
	Right	14	260	
17	Left	3	830	12
	Right	10	560	
18	Left	3	940	8
	Right	10	500	

* Rats were given 1 mg of C^{14}-D-L-phenylalanine/day for 12 days.

The basal rate of secretion of epinephrine from the adrenal gland may be calculated from the data on its rate of turnover. Assuming a half-life of 9 days in the rat, a value of 0.002–0.004 μg/kg of body weight/min is obtained. This value is a maximum one, since it is assumed that epinephrine in the adrenal gland is not chemically altered. The values determined from our isotopic studies are much lower than the basal values of 0.04–0.10 μg/kg/min reported for dogs (*4*), but are in fair agreement with the values of 0.007–0.008 calculated from data reported by Vogt (*5*) for the denervated adrenal gland of the cat. It is conceivable that not all the epinephrine formed in the adrenal gland is pooled with the stored epinephrine before being secreted. A comparison of the specific activity of secreted epinephrine with epinephrine found in storage in the adrenal gland would decide this point. Studies in this laboratory have shown that the epi-

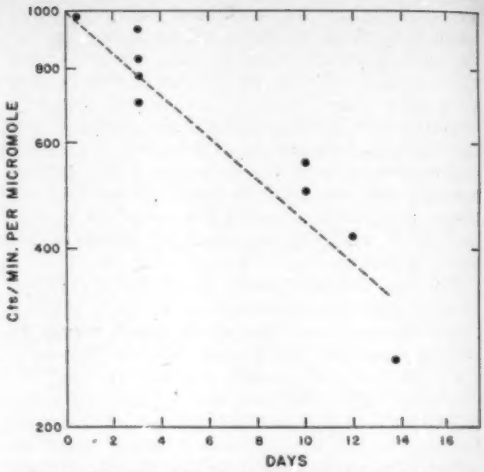

FIG. 1. Radioactive decay of adrenal epinephrine. Measurements were made on adrenals isolated from individual rats at various time intervals after discontinuation of administration of 3-C^{14}-D-L-phenylalanine. The curve was fitted to the data by eye, and it gives an approximation of the rate of radioactive decay.

TABLE 3

EFFECT OF INSULIN ON THE CONCENTRATION OF EPINEPHRINE IN RABBIT ADRENAL GLANDS*

	Time in hr after insulin administration†					
	0	2–4	8–11	24	48	72
Micrograms of epinephrine/g of adrenal gland	749	390	113	445	263	640
	1220	210	531	220	370	687
	1010	479	523		800	534
	888	572	82		430	901
	989	342	163		440	
	921	225				
	1107	283				
	833					
	847					
	1400					
Mean ± standard error of the mean	1026 ± 61	357 ± 50	282 ± 100	333 ± 109	464 ± 87	690 ± 75

* Each value is based on an analysis of the combined adrenal glands of an individual animal. The animals were all males weighing about 2 kg.

† 1.8 units of insulin/kg of body weight were administered subcutaneously. The control animals were injected with saline.

nephrine in the venom gland of the tropical toad *Bufo marinus* turns over even more slowly than the epinephrine in the rat adrenal. From the biochemical standpoint the slow rate of synthesis of epinephrine in the adrenal gland and in the toad venom gland discourages the use of these tissues as sources of active enzymes involved in epinephrine synthesis. It is possible that the rate of turnover of adrenal nor-epinephrine may differ from that of epinephrine. This is now being investigated.

Details of the chemical and isotopic procedures will be presented in a subsequent paper.

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Manuscript received October 23, 1952.

Comments and Communications

On Some Recent Experiments with Supercooled Water

In a paper published in 1944 Rau (*1*) reported the supercooling of water to −72° C by the successive freezing and melting of water droplets in an apparatus which depended upon a dry-ice acetone mixture for cooling. This extremely low temperature prompted Cwilong (*2*) to repeat this work, but he was unable to confirm Rau's results.

During a program on ice physics conducted at the Commonwealth Engineering Company under the auspices of the United States Air Force (*3*) this experiment was repeated.

Using a dry-ice and acetone coolant, a drop of known size was frozen and melted with care to avoid evaporation. The drop was frozen a few times at the same temperature, frozen at a lower temperature, became elongated, and finally did not freeze when the temperature was lowered to −60° C. However, when the identical experiment was repeated using liquid nitrogen as the coolant, a freezing temperature could never be obtained which was lower than −6.5° C. The drop remained hemispherical throughout ten or more repeated freezings and did not elongate.

These data, therefore, indicate that the water in Rau's experiment was contaminated with acetone, as suggested by Cwilong, and that the determination of a −72° C nucleation temperature for pure water is in error. This conclusion is further substantiated by the work of Cohen and Van der Horst (*4*) who were able to obtain ice crystals of similar configuration to those obtained by Rau, when they froze dilute acetone-water solutions.

Recent experimental findings by Smith-Johannsen (*5*) have established that considerable supercooling of bulk water is possible if one takes care to cool the water drop in an apparatus where no air-solid interface below 0° C is in contact with the bulk water. In the Smith-Johannsen apparatus, where a water droplet is cooled on the central region of a plastic surface, which in turn rests upon the top of a cooling bar, nucleation has been found to begin at about −20° C. Using this apparatus we were able to obtain data similar to that reported by Smith-Johannsen and by modifying the apparatus to accommodate considerably larger volumes of water, we found that freezing temperatures of −35° C could frequently be obtained. These extremely low values, we feel, are due to heat-transfer effects within the bulk water and will be the subject of further investigation.

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A Substitute for Drawing Ink in the Preparation of Diagrams for Photographic Reproduction

In seeking a substitute for India or drawing ink in the preparation of graphs, charts, line drawings, and similar items for photographic reproduction, it was found that the pencil "Mars Lumograph" (J. S. Staedtler, Inc.) was most satisfactory. Material prepared with this pencil photographed exceedingly well because of the flat, black line it produced. This was especially true if a high contrast film was used, such as Reprolith or Kodolith. These pencils come in varying degrees of hardness, but the one giving the best over-all results was the EXB grade. For filling in solid areas, as in histograms, however, the EX-EXB grade is recommended. Major advantages over ink are as follows: (1) neatness, in that erasures may be made without frayed or fuzzy lines; (2) increase in speed of preparation, because the need for inking the penciled drawing is eliminated; (3) ease in handling, because the amount of drawing equipment is reduced, and consequently less knowledge of drafting is required; and (4) the degree of blackness produced matches typewriting done with a fresh ribbon, and

all legends may therefore be typed. The only disadvantages noticed were that, in blacking in areas, a fine dust sometimes forms and must be blown off to prevent smudging; and occasionally the lines may have to be gone over twice, especially if a hard smooth-surfaced paper is used.

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Electrophoretic and Chromatographic Studies of Purified Human Profibrinolysin[1]

BY A method previously described (*1*) it has been possible to prepare a human profibrinolysin that appears to be 100% pure electrophoretically. The starting material for this preparation was pyrogenic lyophilized human plasma (supplied by the Office of Naval Research). The one deviation in our current procedure from the previous report is in the first step. Instead of taking the precipitate from dialysis, the starting material is the residue from an acetic acid precipitation at pH 5.2 ± 0.1. In the electrophoretic studies the homogeneity of the single component was tested by reversing the current. The isoelectric point for this single component is pH 6.1; this would indicate profibrinolysin to be a gamma globulin according to reference electrophoretic curves (*2*).

By quantitative chemical methods profibrinolysin was found to be 13.4% nitrogen (micro-Kjeldahl) and 2.03% carbohydrate (orcinol).

Two-dimensional paper chromatograms with phenol and butanol-acetic acid water as developing agents, indicated the following 17 amino acids to be present: alanine, arginine, aspartic, cystine, glutamic, glycine, histidine, hydroxyproline, isoleucine, leucine, methionine, proline, serine, threonine, tryptophane, tyrosine, and valine.

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[1] This study was aided by a grant from the Office of Naval Research.

Horizontal Migration Method of Paper Chromatography

THE method of horizontal migration, which is sometimes referred to as circular paper chromatography (*1*), is a distinct phase in the development of paper chromatography. The method of Rutter (*2*) as modified by Rao and Beri (*3*) involves the use of a circular filter paper on which a small rectangular "tail" is

FIG. 1. *A*, the unknown substance (single or mixture); *B*, the known substance (single or mixture).

cut in such a way that its base lies on the diameter, and its sides are at equal distances from the center. The tail is folded back on its base so that it is perpendicular to the plane of the paper. The substance to be analyzed is introduced at the center as a microdrop. When the solvent rises up the tail and spreads as a halo on the horizontal filter paper, the substance migrates from its point of application and forms a ring and, if a mixture, separates into concentric circular zones. This method is more advantageous than the downward or the upward migration method in speed of development, ease of manipulation, and simplicity

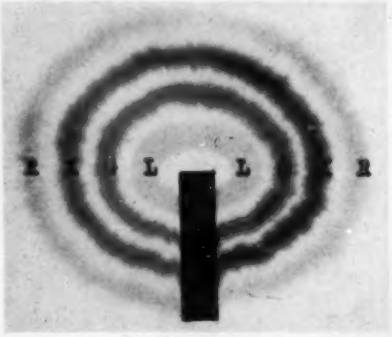

FIG. 2. R, rhamnose; X, xylose; G, galactose; L, lactose (with moist butanol as solvent).

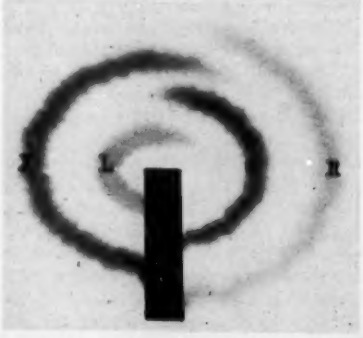

FIG. 3. X, xylose; L, lactose; G, galactose; R, rhamnose (with moist butanol as solvent).

and compactness of the apparatus. It should be noted, however, that a mixture can be separated by this method only when the difference in the circular R_F values of any two components is greater than 0.06.

The original method or the subsequent modification does not provide for a direct positional comparison of known and unknown substances, the identification depending on the determination of the circular R_F values. However, Rao and Giri (*4*) have recently attempted such a comparison by placing the known and the unknown materials in alternate spots along a small ring around the center of the filter paper and running the chromatogram with a suitable solvent. A convenient method has now been developed for running mixed chromatograms. The known and the unknown substances are separately introduced as microdrops (*A* and *B*, Fig. 1) at the two corners where the tail, about 5 mm wide, joins the rest of the filter paper. The introduction of the solutions should be done in such a way that the two microdrops come as close to each other as possible but do not actually touch as shown in the figure.

When the chromatogram is run in the usual way (*3*), the substances spread themselves as semicircular rings. The latter more or less touch each other to form complete circular rings if the substances are identical; otherwise they remain merely as concentric semicircles facing each other. The chromatograms with the same and with different materials are shown in Figures 2 and 3.

For purposes of identification the substance or the mixture to be analyzed is introduced at *A* and the reference compound or compounds at *B* (Fig. 1), and the chromatogram is run with an appropriate solvent. As already pointed out elsewhere (*3*, *5*), for confirming the identity, replicate chromatograms should be developed with two or more different solvents. It may be noted in this connection that the circular R_F values are in no way affected by the modification in the technique.

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[1] The senior author, whose permanent address is Forest Research Institute, Dehra Dun, India, is indebted to The Institute of Paper Chemistry for a Fellowship and to the Government of the U. S. for a Fulbright Travel Grant.

Book Reviews

Micrometeorology: A Study of Physical Processes in the Lowest Layers of the Earth's Atmosphere. O. G. Sutton. New York–London: McGraw-Hill, 1953. 333 pp. Illus. $8.50.

Meteorology, the observational and theoretical study of our atmosphere, concerned itself at first merely with the large-scale aspects of weather and climate. In recent years increasing attention has been given to the special problems which arise in connection with the investigation of the atmospheric layers next to the ground. These layers are of particular importance both for meteorology in general and for practical reasons. It is these lowest layers which, by their roughness, provide the breaking action for atmospheric motion and which determine primarily the transfer of heat and water vapor from the solid ground and from the water surfaces to the atmosphere as a whole; hence their importance for meteorology in general. Furthermore, human activities take place almost exclusively in these lowest layers; hence their practical importance for such varied fields as agriculture and the investigation of atmospheric pollution. A peculiarity of this atmospheric boundary layer is the rapid change of the meteorological parameters, such as wind, temperature, and humidity over small distances, caused by changes in the properties of the underlying surface.

The term micrometeorology, as used by Professor Sutton, deals with the study of the physical phenomena taking place in these lowest atmospheric layers. A broader definition might also be taken to include such micrometeorological phenomena as the fine structure of upper atmospheric phenomena and the microphysics of clouds. But because of the large amount of information to be discussed the author wisely restricts himself to the more narrow field of the surface layers. Even here he does not touch at all on the importance of atmospheric effects on radio wave propagation, referring merely to existing accounts of this subject. Nevertheless, even specialists in this field will profit greatly by a study of *Micrometeorology* because the author presents an integrated picture of the present state of our knowledge of the distribution of meteorological parameters affecting electromagnetic wave propagation.

Micrometeorology is written so that it can be read by anyone who has acquired the "standard of an initial degree in mathematics and physics," and no initial knowledge of meteorology is assumed. Instead Sutton presents this, to the extent that it is required for the study of micrometeorology, in a concise and very readable fashion throughout his book. Accordingly the first chapter deals with "The Atmosphere at Rest." The next two chapters treat of "The Atmosphere in Motion" and discuss first laminar, then tur-

bulent flow. Among the topics included in these chapters are Prandtl's boundary layer theory and the statistical and similarity theories of turbulence. Chapter IV takes up the discussion of heat transfer and diffusion; Chapter V surveys radiation and its micrometeorological significance. These first five chapters, slightly more than half of the book, thus lay the groundwork for the more detailed discussions in the latter part of the book—namely, the temperature field (Chap. VI), the wind structure (Chap. VII), and diffusion and evaporation (Chap. VIII).

A wealth of data has been accumulated, especially during and since the last war, on the distribution of wind, temperature, humidity, and the spread of particulate matter. Many of these observations cannot be compared with each other without great reservations because of the different observational techniques employed and because of the difficulty which meteorology shares with the other earth sciences—that instead of controlled laboratory experiments, information has to be gathered, with a few exceptions, by direct observation of natural phenomena as they occur. A critical collection of these data would be a highly desirable task, but it would be quite impossible within the scope of Professor Sutton's book. Consequently, he restricts the presentation of data to typical illustrative examples which demonstrate the successes and inadequacies of the various hypotheses aimed at a theory of the meteorological phenomena and the fields of meteorological parameters observed in the surface layers. Thus the last three chapters stress the theoretical advances in micrometeorology to which the author has contributed so much. Nevertheless, a great deal of observational information will also be found here for readers seeking mainly factual information on the behavior of the lowest atmosphere. The book contains more than 230 references to original articles which will guide the specialist to more detailed studies of any particular problem.

There are only a few minor points on which the reviewer would want to take issue with the author. It is not general meteorological practice to use the surface pressure as the standard for defining potential temperature (p. 10). As another example (p. 26), it would have been desirable in conjunction with the discussion of the permanence of irrotational motion in inviscid fluids to point out specifically that this applies only to the incompressible or barotropic fluids of classical hydrodynamics.

The book is very well written and the presentation of the quantitative, mathematically formulated theories is clear and easy to follow. The author expresses the hope that the book will help to increase the number of micrometeorologists. Since the book sums up in a well-organized presentation our present knowledge of the subject it will not fail to do so. Meteorologists in general, and specialists in micrometeorology and in fields for which the physics of the lowest atmospheric layers is important, will be grateful to the author for providing them with an authoritative account of a very important branch of the science which is in rapid and vigorous development.

B. Haurwitz
Department of Meteorology and Oceanography
New York University

Scientific Book Register

Man's Foods. Nutrition and environments in food gathering and food producing times. Lloyd B. Jensen. Champaign, Ill.: Garrard Press, 1953. 278 pp. $4.50.

Analytic Geometry and Calculus. Lloyd L. Smail. New York: Appleton-Century-Crofts, 1953. 644 pp. and appendices. Illus. $5.50.

Problems of Infancy and Childhood. Transactions of the Sixth Conference, March 17–18, 1952, New York. Milton J. E. Senn, Ed. New York: Josiah Macy, Jr. Fdn., 1953, 160 pp. $2.50.

Principles of Modern Acoustics. George W. Swenson, Jr. New York–London: Van Nostrand, 1953. 222 pp. Illus. $4.00.

Stochastic Processes. J. L. Doob. New York: Wiley; London: Chapman & Hall, 1953. 654 pp. $10.00.

The Dynamical Character of Adsorption. J. H. de Boer. New York: Oxford Univ. Press, 1953. 239 pp. Illus. $6.00.

A Textbook of General Botany. 5th ed. Gilbert M. Smith *et al.* New York: Macmillan, 1953. 606 pp. Illus. $6.25.

Introduction to the Theory of Statistics. Victor Goedicke. New York: Harper, 1953. 286 pp. Illus. $4.50.

Prehistoric Settlement Patterns in the Virú Valley, Perú. Smithsonian Institution, Bureau of American Ethnology, Bull. 155, 1953. Gordon R. Willey. Order from Supt. of Documents, GPO, Washington, D. C. 453 pp. Illus., maps, and plates. $4.00.

Elements of Cartography. Arthur H. Robinson. New York: Wiley; London: Chapman & Hall, 1953. 254 pp. Illus. $7.00.

Manual of Comparative Anatomy. 2nd ed. Osmond P. Breland. New York–London: McGraw-Hill, 1953. 256 pp. $4.50.

The Official Preparations of Pharmacy. 2nd ed. Charles Oren Lee. St. Louis: Mosby, 1953. 544 pp. Illus. $5.50.

Textile Fibers, Yarns, and Fabrics. A comparative survey of their behavior with special reference to wool. Ernest R. Kaswell. New York: Reinhold, 1953. 552 pp. Illus. $11.00.

Cellulose: The Chemical That Grows Williams Haynes. Garden City, N. Y.: Doubleday, 1953. 386 pp. + plates. $4.00.

The Bile Pigments. C. H. Gray. London: Methuen; New York: Wiley, 1953. 142 pp. Illus. $1.75.

Liver Injury. Transactions of the Eleventh Conference, April 30 to May 1, 1952, New York. F. W. Hoffbauer, Ed. New York: Josiah Macy, Jr. Fdn., 1953. 265 pp. Illus. $4.00.

Radioisotopes in Industry. John R. Bradford, Ed. New York: Reinhold, 1953. 309 pp. Illus. $8.00.

Progress in the Chemistry of Fats and Other Lipids, Vol. 1. R. T. Holman, W. O. Lundberg, and T. Malkin, Eds. New York: Academic Press; London: Pergamon Press, 1952. 186 pp. Illus. + plates. $7.00.

Encyclopedia of Chemical Reactions, Vol. V. C. A. Jacobson, Ed. and Compiler, with assistance of Clifford A. Hampel and Elbert C. Weaver. New York: Reinhold, 1953. 787 pp. $15.00.

The Wiley Bulletin

SCIENCE EDITION

New York — June 12, 1953

FIRST PUBLICATION IN EXPANDING FIELD

Microwave spectroscopy, practically non-existent before World War II, is still a young field, but is no longer small. Its rise has been so recent and so rapid that a recent bibliography lists only one paper before 1946 — but 157 in 1951! The field has been so quickly developed that not until last month was there a book on the subject. At that time "Microwave Spectroscopy" was published.

Written at Duke University by Professors Walter Gordy, William V. Smith, and Ralph Trambarulo, this new book provides a convenient source for the large amount of information obtained to date through microwave spectroscopy. Summarizing information in various tables, it provides the key to an easy familiarity with the instruments and experimental techniques used. It gives detailed descriptions of significant spectrographic components and supplies the fundamental theory involved in the detection of microwave adsorption lines. It contains 446 pages and is priced at $8.00.

TWO FISHERY EXPERTS HIT BASIC PROBLEM

Heretofore, students of fishery science have had to comb the literature for much of their information. Now, however, a new book "Fishery Science: Its Methods and Applications," solves that problem by presenting the first opportunity to study the material under one cover. In it, two experts, George A. Rounsefell, Department of the Interior, and W. Harry Everhart, University of Maine, skillfully blend the great mass of accumulated knowledge, integrating the most successful and specialized methods employed in the research, conservation, and management of fishery resources regardless of where the fish occur. Moreover, theirs is the first book to approach fishery science with the general philosophy that fresh water and marine fisheries management are essentially the same.

They state the basic purpose of the text in the Preface: ". . . to present the problems that confront the administrator, the research worker, and the student, and to show how to go about solving them."

"Fishery Science" was published last month with 444 pages and at $7.50.

ANOTHER "ISM" AT WORK

Communism is not the only "ism" affecting our lives today. Nationalism, long a potent factor in the historical development of nations, has once again jumped into the headlines. Of the two, it is the lesser known and understood, although it has longer played a role in history. There are good historical studies of nationalistic ideas; competent descriptions of its force in politics, important summaries of a particular problem — but little has been said about why it occurs at certain times and places and not at others. Little has been written on the subject of ethnic nationalism.

What is ethnic nationality? Under which conditions will it be a political asset? When a liability? What is its relation to economic life, to incomes, opportunities, and expectations. And how can it override all other considerations?

Professor Karl W. Deutsch of M.I.T., in his new book, "Nationalism and Social Communication," attempts to answer some of these questions both subjectively and objectively. He attempts structural and quantitative analyses of nationalism as groundwork for eventual measurement and prediction in this field. He applies new ideas of communication theory and cybernetics to a fundamental social science problem, and evolves a theory that can be applied to research on concrete situations. His is an interdisciplinary study that draws upon many pertinent research methods and results, available only since World War II.

Dr. Deutsch was awarded the Sumner Prize in Political Science from Harvard University in 1951 for the manuscript of "Nationalism and Social Communication". The book will be published next month with approximately 272 pages and a probable price of $5.00. A Technology Press book, M.I.T.

NEW FIELD GETS INTRODUCTORY TREATMENT: BASIC SOLID STATE PHYSICS DISCUSSED

Only recently has solid state physics become a field in its own right. It is a wide field and includes many branches, although it is concerned with the physical properties of solids, particularly the special properties exhibited by atoms and molecules because of their association in the solid phase. One large force in the unification of solid state physics has been the existence of powerful theoretical methods and concepts applicable to a wide range of problems. It is, therefore, quite natural that the first elementary book on the subject should emphasize theoretical models of solids rather than details of techniques or the results of measurement.

Professor Charles Kittel of the University of California has written this first and only book on an introductory level to cover a large part of the field: "Introduction to Solid State Physics." It gives a basic and concise discussion of representative areas and emphasizes those areas of active research in solids which may be discussed in terms of simple physical models. He keeps the experimental situation in mind with the aid of graphs and tables of data, yet holds the book to a basic and short account of the subject. Published last month, it is 396 pages long and costs $7.00.

Any of the books on this page may be obtained on approval by writing directly to the publishers:
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Meetings & Conferences

June 15–17. American Society of Agricultural Engineers (Annual). William Penn Hotel, Pittsburgh.
June 15–17. American Neurological Association (Annual). Hotel Claridge, Atlantic City, N. J.
June 15–18. American Society of Mammalogists. American Museum of Natural History, New York.
June 15–18. American Chemical Society Organic Chemistry Symposium. University of Michigan, Ann Arbor.
June 15–19. American Society of Civil Engineers. Miami Beach, Fla.
June 15–19. Canadian Medical Association (Annual). Winnipeg.
June 15–19. Symposium on Molecular Structure and Spectroscopy. The Ohio State University, Columbus.
June 15–19. American Institute of Electrical Engineers (Summer General). Chalfonte-Haddon Hall, Atlantic City, N. J.
June 15–20. American Association for the Advancement of Science. Pacific Division. Santa Barbara, Calif.
June 15–20. Astronomical Society of the Pacific (with AAAS), Santa Barbara, Calif.
June 15–20. Western Society of Naturalists (with AAAS). Santa Barbara, Calif.
June 16–17. Symposium on Impurity Phenomena. Research Laboratory, General Electric. Schenectady, N. Y.
June 16–18. Division of Physical and Inorganic Chemistry. Summer Symposium. Schenectady, N. Y.
June 16–18. American Meteorological Society (with AAAS). Santa Barbara, Calif.
June 16–19. Medical Library Association (Annual). Salt Lake City.
June 16–24. International Congress on Electro-acoustics and Symposium on Sound Insulation of Light-weight Structures. The Hague, Hilversum, Delft, Eindhoven.
June 18. Symposium on Crystal Chemistry as Applied to Ceramics. MIT, Cambridge, Mass.
June 18–20. American Physical Society. University of Rochester, Rochester, New York.
June 18–29. International Congress of Industrial Chemistry (26th). Paris.
June 19–20. Division of Analytical Chemistry (6th annual Summer Symposium). Troy, N. Y.
June 19–21. Society for Applied Anthropology. University of Chicago.
June 19–21. Symposium of the Society for the Study of Development and Growth (12th). University of New Hampshire, Durham.
June 20. American Mathematical Society. Missoula, Mont.
June 20–24. Laboratory Conference for Teachers of Science and Mathematics. Duke University, Durham, N. C.
June 21–27. American Library Association (Annual). Los Angeles.
June 21–27. World Conference on Endodontics. Philadelphia.
June 22–23. American Chemical Society. Symposium on the Chemistry of High Polymers. University of Minnesota, Minneapolis.
June 22–24. American Dairy Science Association (Annual). University of Wisconsin, Madison.
June 22–25. Special Libraries Association. Toronto.
June 22–26. American Crystallographic Association. University of Michigan, Ann Arbor.
June 22–27. Industrial Microbiology Institute. Purdue University. Lafayette, Ind.

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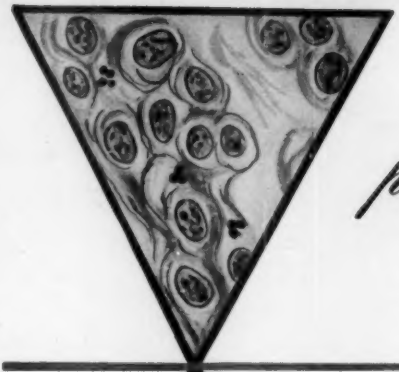

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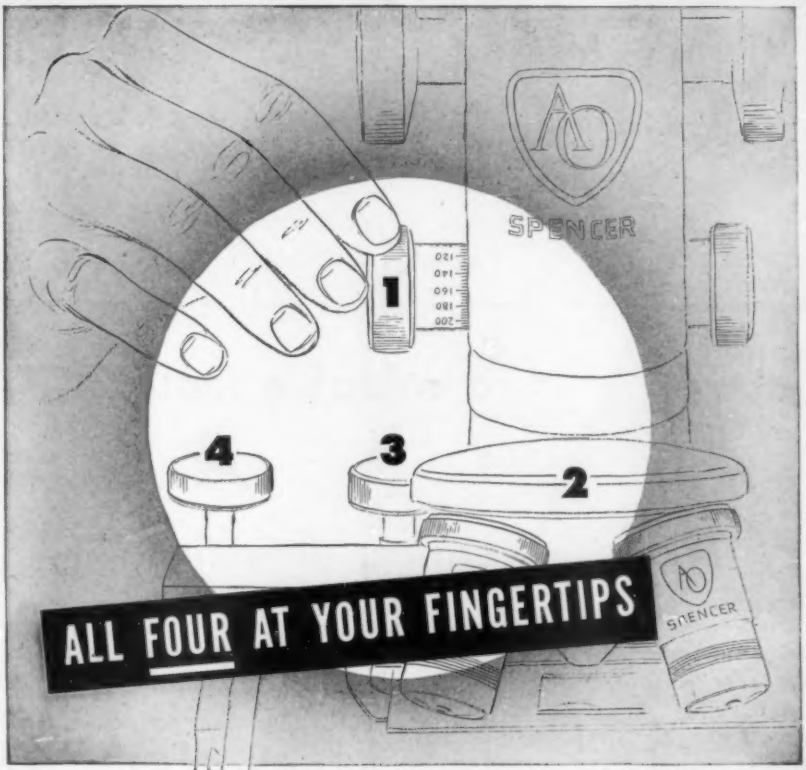

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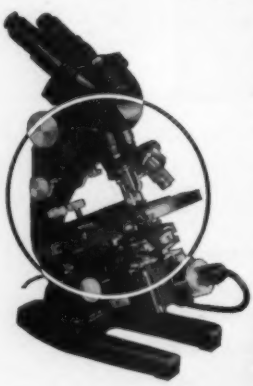

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